CATALOGUE OF

# UNITED STATES NAVAL POSTGRADUATE SCHOOL

MONTEREY CALIFORNIA

NAVPERS 15779

1952-1953

# UNITED STATES NAVAL
# POSTGRADUATE SCHOOL

## CATALOGUE
## for the
## Academic Year 1952--1953

## MONTEREY, CALIFORNIA

## 1 JULY 1952

12NDP991

9536—NAVY—MI-DPPO12ND 5-22-52—2500

Entrance to the Main Building, which houses the Administrative Offices and Bachelor Officers' Quarters of the U. S. Naval Postgraduate School.

An aerial view of the School showing the interim laboratories in the foreground and the Naval Auxiliary Air Station in the upper background.

# TABLE OF CONTENTS

## SECTION I

### U. S. NAVAL POSTGRADUATE SCHOOL



## SECTION II

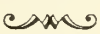
### ENGINEERING SCHOOL OF THE U. S. NAVAL POSTGRADUATE SCHOOL

## SECTION III

### GENERAL LINE SCHOOL OF THE U. S. NAVAL POSTGRADUATE SCHOOL

# SECTION I

# U. S. NAVAL POSTGRADUATE SCHOOL



# PART I—GENERAL INFORMATION

## 1. HISTORICAL

The brief historical sketch which follows traces the evolution of the Naval Postgraduate School from its modest beginning at the Naval Academy in 1909 with a class of ten officers enrolled in one curriculum—Marine Engineering—to the present day in its new location at Monterey, California, with more than nine hundred officer students in twenty-seven curricula in engineering and related subjects in the Engineering School, and in the General Line School. The growth and development of the School has been in keeping with its original objective of providing the Navy with officers of advanced technical education capable of administering and directing a modern Navy.

The need for technically trained officers became evident at the turn of the century. The idea of a naval graduate school had its inception in a course of instruction in Marine Engineering which the Bureau of Engineering instituted in 1904. The results of this course were so encouraging that in 1909 the Secretary of the Navy established a School of Marine Engineering at the Naval Academy in Annapolis. In 1912 the School was designated the Postgraduate Department of the U. S. Naval Academy.

The operation of the School was temporarily suspended during World War I. In 1919 classes were resumed in the converted Marine Barracks on the Naval Academy grounds. At this time curricula in Mechanical Engineering and Electrical Engineering were added. With the passing years other curricula—Ordnance Engineering, Radio Engineering and Aerological Engineering—were added as the Navy's need for officers with technical knowledge in these fields became evident.

In 1927 the General Line School was established within the Postgraduate Department to provide courses of instruction to acquaint junior line officers returning from sea duty with modern developments taking place in the Navy. The courses dealt with naval and military subjects for the most part. The General Line School remained as an integral part of the Postgraduate Department until the declaration of the emergency prior to the outbreak of World War II, at which time it was discontinued because of the need for officers in the growing fleet.

The enrollment in the Postgraduate Department increased rapidly in the war years both in the several engineering curricula and in the communications curriculum which was added to meet the need for trained communication officers in the naval establishment. The School outgrew its quarters necessitating the building of an annex to house the additional classrooms and laboratories required. Even with this addition, the space requirements of the expanded school were not met.

The post-war program called for yet further expansion and the re-establishment of the General Line School with a greatly increased enrollment. In 1946 the General Line School was established at Newport, Rhode Island, as an outlying element of the Postgraduate Department; and in 1948 an additional General Line School was established at Monterey, California. The objective of the General Line School program for the re-established schools—that of providing an integrated course in naval science to broaden the professional knowledge of unrestricted line officers of the Regular Navy—continued in effect as it had since the inception of this program. The current curriculum is designed to provide such a course of approximately one year in length for ex-reserve and ex-temporary officers who have transferred to regular status.

The physical growth of the School and its increase in scope and importance were recognized in Congressional action which resulted in legislation during the years 1945 to 1951 emphasizing the academic level of the School, establishing the School as a separate naval activity, and providing for continued growth in a new location with modern buildings and equipment. This legislation authorized the School to confer Bachelor of Science, Master of Science, and Doctor's degrees in engineering and related subjects; created the position of Academic Dean to insure continuity in academic policy; established the School as a separate naval activity to be known as the United States Naval Postgraduate School; authorized the establishment of the School at Monterey, California; and provided funds to initiate the construction of buildings to house modern laboratories and classrooms at that location.

On 22 December 1951, by order of the Secretary of the Navy, the United States Naval Postgraduate School was officially disestablished at Annapolis, Maryland, and established at Monterey, California. Concurrently with this relocation, the U. S. Naval School (General Line) at Monterey was disestablished as a separate military command and its functions and facilities were assumed by the U. S. Naval Postgraduate School. At the same time there was established the U. S. Naval Administrative Command, U. S. Naval Postgraduate School, Monterey, to provide logistic support, including supply, public works, medical and dental functions, for the Naval Postgraduate School and its components.

During the period 21 November 1951 to 16 February 1952, the entire school at Annapolis—faculty, students and equipment, was moved to Monterey. This move, unique in character, involved the transcontinental transportation of approximately five hundred families, civilian and military, their household effects, and some three million pounds of school equipment. What had been the U. S. Naval Postgraduate School, Annapolis, was redesignated the Engineering School of the Naval Postgraduate School.

The U. S. Naval Postgraduate School, Monterey, now comprises the Engineering School under a Director, the General Line School under a Director, and the Administrative Command under a Commanding Officer. In command of the Naval Postgraduate School and all of its components is a line officer of flag rank in the Regular Navy with the title of Superintendent.

## 2. POSTGRADUATE SCHOOL PROGRAM

The program for the advanced education and training of commissioned officers in general and technical subjects according to the Navy's need is under the cognizance and direction of the Superintendent of the U. S. Naval Postgraduate School. From officers applying for postgraduate instruction and from officers nominated by the technical bureaus and other activities of the Navy, candidates are selected by boards appointed by the Chief of Naval Personnel. The U. S. Army, U. S. Air Force, and U. S. Coast Guard also select officers from their respective services to participate in certain of the postgraduate curricula conducted at the U. S. Naval Postgraduate School.

Postgraduate education is conducted at the U. S. Naval Postgraduate School in Monterey and at many civilian institutions which cooperate in providing special curricula to meet the requirements of the Navy.

For the most part, all officer students commence their postgraduate education at the Naval Postgraduate School in Monterey. General Line School students attend for a course of approximately one year. Engineering School students, depending on the curriculum to which assigned, may attend one, two, or three years at the School, or one or two years at the School and one or two years subsequently at a civilian university. The curricula commencing in the Engineering School at Monterey are set forth in Part III of this section. Exceptions to the procedure set forth above are made in the cases of certain non-engineering curricula, e. g. Law, Business Administration, Theology, for which the entire postgraduate education is conducted at appropriate civilian institutions. These curricula and the institutions at which the instruction is conducted are set forth in Part IV of this section.

## 3. COMPONENTS OF THE U. S. NAVAL POSTGRADUATE SCHOOL

Engineering School located at Monterey, California, comprises the engineering and scientific division which was formerly located at Annapolis, Maryland. The School is supervised and administered by a Director who is a line officer of the Regular Navy of the rank of Captain.

General Line School located at Monterey, California, provides a one-year curriculum in professional naval subjects to round out the junior naval officer's training to better fit him for continued general duties afloat and ashore. The current curriculum is designed to supplement the training of reserve and temporary officers who have transferred to the Regular Navy. The school is under the supervision of a Director who is a line officer of the Regular Navy of the rank of Captain.

Administrative Command located at Monterey was established to provide logistic support to the Engineering School and the General Line School. It is a separate military command under a Commanding Officer who is a line officer of the Regular Navy of the rank of Captain.

**General Line School** located at Newport, Rhode Island, although not being used at present in the General Line School program has not been disestablished. The School is a separate military command under a commanding officer who is a line officer of the Regular Navy of the rank of Captain.

**Naval Intelligence School** located at Anacostia, D. C., provides training in naval intelligence and foreign language instruction. The School is under a commanding officer who is a line officer of the Regular Navy of the rank of Captain.

## 4. LOCATION AND FACILITIES

The Naval Postgraduate School is located northeast of the city of Monterey, California, on the grounds and in the buildings of the former Hotel Del Monte. The hotel buildings have been converted into laboratories, classrooms, offices, and living quarters to serve as an interim establishment until the completion of modern permanent buildings, construction of which started in June 1952 with the Engineering School building.

The construction program, when finished, will provide modern buildings to house the Engineering School, the General Line School, Library, Gymnasium, Auditorium, Chapel, and the various supporting activities such as the Infirmary, and Barracks, and Messhalls for enlisted personnel. The Engineering School will comprise the following elements: a main building of five stories housing the Departments of Electronics and Physics, Chemistry and Metallurgy, and Aerology; an Electrical Engineering Laboratory building; a Mechanical Engineering and Aeronautical Engineering Laboratory building; a building housing the Mathematics Department and most of the classrooms and drafting rooms of all departments; a Heating Plant; a Lecture Hall; a Steam Engineering Laboratory located on the beach adjacent to the main campus for the joint use of the Engineering School and General Line School; an Ordnance and Gunnery Laboratory also located on the beach and for the joint use of both schools; and an Aeronautical Engineering building located adjacent to the Naval Auxiliary Air Station housing the trans and supersonic wind tunnels and the jet engine pits.

The property acquired in the purchase of the site consists of some 604 acres lying to the north of the city of Monterey. The buildings and the campus proper, lying between two major California highways, occupy 133 acres of beautifully landscaped and wooded grounds. In laying out the new buildings, the Navy has gone to great lengths to retain the valuable trees, landscaping, and shrubbery which has made this location one of California's most beautiful resorts.

## 5. STUDENT HOUSING

**For Married Officer Students.** The Housing Office of the U. S. Naval Postgraduate School maintains an up-to-date list of available houses and apartments in the Monterey Peninsula area. In addition, there is a Navy Wherry Housing Project (La Mesa Village) located about one mile from the School, consisting of 135 units now in operation with an additional 384 units scheduled for completion by October, 1952.

The Wherry Housing units consist of unfurnished, except for stove, refrigerator, heater and blinds, apartments and houses with one to three bedrooms which rent from $70.00 to $107.00 per month plus cost of utilities. Applications for Wherry Housing should be submitted through the Housing Office of the School. Military personnel attached to the School and to the Naval Auxiliary Air Station have first call on this Wherry Housing. Applications can be obtained from the Housing Office of the School. A brochure containing detailed information (floor plans, etc.) will be mailed to officers addressing a request to the Superintendent, U. S. Naval Postgraduate School (Attention: Housing Officer).

Rentals in the Monterey Peninsula area average somewhat higher than in most other places because it is a popular resort area. Desirable housing, however, can be found but it is wise to arrive early and get located prior to commencing classes.

**B.O.Q. and Closed Mess.** A B.O.Q. and a Closed Mess which can accommodate approximately 150 officers are located in the main building (a portion of the former Hotel Del Monte). Officers intending to occupy the B.O.Q. should make application to the Superintendent, U. S. Naval Postgraduate School (Attention: B.O.Q. Officer).

## 6. LIBRARY FACILITIES

The Library of the Naval Postgraduate School consists of various collections of published materials intended to furnish students of both the Engineering School and the General Line School with books, periodicals, pamphlets, and newspapers necessary in their studies and thesis work. In addition to the above material, the Library receives and catalogues research publications of the various Department of Defense activities, contractors, and other civilian research agencies, adding them to its collections for use of students and faculty members.

The Reference Library, temporarily located on the ground floor of the Administration Building, now has in its collections approximately 35,000 books—15,000 volumes of periodicals and 60,000 research and development reports. It receives 581 periodicals, including technical and scientific Government publications from the Superintendent of Documents which are obtained on a selective depository basis. There is, in addition to the Reference Library, a Technical Text Library which contains approximately 70,000 textbooks and pamphlets used in classroom work by students and instructors. These volumes, of which this Library has multiple copies, are issued to students on a term loan basis and to instructors for an unlimited period. There is also the Christopher Buckley collection, a special group of about 3,000 books relating mainly to the Navy and to the sea. It is separately housed and forms a browsing collection in comfortable surroundings conducive to reading and relaxing.

The Library furnishes reference and loan services to students, faculty, and administrative staff from 8.00 a.m. to 5:30 p.m., and from 7:00 p.m. to 10:00 p.m., Monday through Friday. On weekends, the Library is open for similar services from 8:00 a.m. to 12:00 p.m. on Saturday, and from 7:00 p.m. to 10:00 p.m. on Sunday.

The Library has established relationships with the Navy Research Section of the Library of Congress, the Central Air Documents Office, and with many Government and university libraries throughout the country. From these sources, it can secure on inter-library loan or permanent retention basis any material it does not own. Inter-library loan service is provided for all persons connected with the School. Microfilm and photostat services are also available.

Aerial view of "La Mesa Village," Wherry Housing Project.

Main Lobby—Administration Building.

# PART II—STAFF AND FACULTY

## 1. MILITARY STAFF

### SUPERINTENDENT'S STAFF

ERNEST EDWARD HERRMANN, Rear Admiral, U. S. Navy
Superintendent

CHARLES EDWIN CROMBE, JR., Captain, U. S. Navy
Aide and Chief of Staff

WARREN FULLER ANDERSON, Commander, U. S. Navy
Aide and Flag Secretary

RICHARD PAUL WENZLIK, Lieutenant, U. S. Navy
Aide and Flag Lieutenant

PAUL LAWRENCE HATHAWAY, Commander, U. S. Navy
Comptroller

FREEMAN MARVILLE JONES, Lieutenant Commander, U. S. Navy
Administrative Assistant and Public Information Officer

### ADMINISTRATIVE COMMAND

THOMAS CARSON PHIFER, Captain, U. S. Navy*
Commanding Officer

ROBERT WALLACE McELRATH, Commander, U. S. Navy
Executive Officer

BENJAMIN FRANK EDWARDS, JR., Commander, U. S. Navy
First Lieutenant

CHARLES HOLLIS SARVER, Lieutenant, U. S. Navy
Special Services Officer

CLAYTON FORSLING JOHNSON, Lieutenant, U. S. Navy
Closed Mess and BOQ Officer

LEWIS STANLEY HELMECI, Lieutenant, U. S. Navy
Communications Officer

JUNE MARGARET COGSWELL, Lieutenant, U. S. Navy
Custodian Registered Publications

BASIL THOMAS MORRISON, Lieutenant, U. S. Navy*
Personnel Officer

WILLIAM MALCOLM CALKINS, Lieutenant, U. S. Navy**
Personnel Officer

HARRY EDWARD HOWELL, Ship's Clerk, U. S. Navy
Assistant Personnel Officer

---

* To be detached. ** To report.

**Medical**

LLOYD BERTRAM SHONE, Captain, U. S. Navy
Senior Medical Officer

BRUCE MORGAN, SHEPARD, Commander, U. S. Navy
Medical Officer

CHARLES L. JERNSTROM, Lieutenant (junior grade), U. S. Navy
Assistant Medical Officer

THOMAS F. McGUIRE, Lieutenant (junior grade), U. S. Navy
Assistant Medical Officer

CHARLES V. CARLSON, Lieutenant (junior grade), U. S. Navy
Assistant Medical Officer

WILLIAM CAMPBELL BLAIR, Lieutenant (junior grade), U. S. Navy
Assistant Medical Officer

CLAUDE CRAWFORD CASON, Lieutenant, U. S. Navy
Medical Services Officer

**Dental**

REIMERS DORAN KOEPKE, Captain, U. S. Navy
Dental Officer

HENRY JULIAN SANCIER, Lieutenant, U. S. Navy
Assistant Dental Officer

CURTIS CHARLES DARBY, Lieutenant, U. S. Navy
Assistant Dental Officer

**Chaplain**

WALTER ALBERT MAHLER, Commander, U. S. Navy
Chaplain

**Supply**

BEN SAULE GANTZ, JR., Lieutenant Commander, U. S. Navy
Supply Officer

ROBERT TAFT ALBRIGHT, Lieutenant, U. S. Navy
Officer-in-Charge Branch Navy Exchange

JOHN LUFKIN POOR, Lieutenant, U. S. Navy
Disbursing Officer and Assistant to the Supply Officer

CHARLES LOUIS CULWELL, Lieutenant (junior grade), U. S. Navy
Assistant Supply Officer

**Public Works**

WILLIAM WASHINGTON MOORE, JR., Commander, U. S. Navy
Public Works Officer and Resident Officer-in-Charge of Construction

FRANCIS XAVIER CONNELLY, Lieutenant Commander, U. S. Navy
Assistant to Resident Officer-in-Charge of Construction

MELVIN EUGENE SCANLAN, Lieutenant, U. S. Navy
Assistant Public Works Officer

WHITNEY BURFORD JONES, Lieutenant, U. S. Navy
Assistant Public Works Officer

BYRON CURTIS McKINNEY, Carpenter, U. S. Navy
Assistant Public Works Officer

NOTE: The military staff of the Engineering School and the General Line School is listed in the corresponding section of the catalogue devoted to those schools.

## 2. CIVILIAN FACULTY

ROY STANLEY GLASGOW, B.S., M.S., E.E.
Academic Dean

RALPH EUGENE ROOT, B.S., M.S., Ph.D.
Senior Professor of Mathematics (Emeritus)

LIBRARY

GEORGE RIDGELY LUCKETT, B.S., M.S.L.S.
Associate Professor, Librarian

MORRIS HOFFMAN, B.S., M.A.
Assistant Professor, Associate Librarian

NOTE: The civilian faculties of the Engineering School and the General Line School are listed in the corresponding section of the catalogue devoted to those schools.

# PART III

## GROUPS RECEIVING ENTIRE POSTGRADUATE EDUCATION AWAY FROM THE POSTGRADUATE SCHOOL, MONTEREY, CALIFORNIA

The curricula pursued by these groups are under the cognizance of the Superintendent, U. S. Naval Postgraduate School. The latest Bureau of Naval Personnel Circular Letter on "Applications for Postgraduate Instruction" should be consulted to determine eligibility and approximate convening dates.

| Curriculum | Group Designator | University or School Where Given |
|---|---|---|
| Business Administration | ZKC | Columbia University |
| Business Administration | ZKH | Harvard University |
| Business Administration | ZKS | Stanford University |
| Cinematography | ZCP | University of Southern California |
| Civil Engineering | ZG | Rensselaer Polytechnic Institute |
| Comptrollership | ZS | George Washington University |
| Hydrographic Engineering | ZV | Ohio State University |
| Law | ZHC | Catholic University |
| Law | ZHG | Georgetown University |
| Law | ZHW | George Washington University |
| Management and Industrial Engineering | ZT | Rensselaer Polytechnic Institute |
| Naval Construction and Engineering | ZNB | Webb Institute of Naval Architecture |
| Naval Intelligence | ZI | U. S. Naval School, Naval Intelligence |
| Nuclear Engineering (Advanced) | ZNE | Massachusetts Institute of Technology |
| Oceanography | ZO | Scripps Institute of Oceanography |
| Personnel Administration and Training | ZP | Stanford University |
| Petroleum Engineering | ZL | University of Pittsburgh |
| Photography | ZCR | Rochester Institute of Technology |
| Religion | ZU | Various Universities |
| Structural Dynamics | ZSD | University of Illinois |
| Textile Engineering | ZM | Georgia Institute of Technology |

## DESCRIPTION

### BUSINESS ADMINISTRATION (ZKC, ZKH, ZKS)

A two-year course at Columbia University, Harvard University, or Stanford University. It is designed to develop in the student officer the ability to analyze business organizations, problems, and conditions; to give them an appreciation and understanding of business as a whole; and to prepare them for future assignments which may require personal dealings with business and industrial concerns, or the utilization of business techniques. Students completing this curriculum normally qualify for a Master of Science degree.

### CINEMATOGRAPHY (ZCP)

A one-year course at the University of Southern California, given to officers with previous experience in this field, to prepare them for assignment to duties in connection with the production of training films and motion picture reports.

### CIVIL ENGINEERING (Qualification) (ZG)

Seventeen months of instruction at Rensselaer Polytechnic Institute to qualify officers for civil engineering duties and a scientific degree in engineering. Successful completion of this course normally leads to appointment in the Civil Engineering Corps. At present this is the only program for tranfer of line officers to the Civil Engineer Corps.

### CIVIL ENGINEERING (Advanced) (ZG)

Fourteen months of advanced technical instruction at Rensselaer Polytechnic Institute normally leading to a degree of Master of Civil Engineering. Officers selected for this course will normally be CEC officers of the ranks of lieutenant and lieutenant (junior grade) who have a degree in Civil Engineering and have completed three years of commissioned service.

### COMPTROLLERSHIP (ZS)

A one-year course at George Washington University which prepares officers who have a broad background of professional experience for key supervisory and planning positions in comptroller-type billets throughout the Navy. Provided the student officer has adequate educational background, this curriculum normally leads to a Master of Science degree.

### HYDROGRAPHIC ENGINEERING (ZV)

A one-year course in Hydrographic Engineering given at Ohio State University to officers nominated by the Hydrographer. The curriculum presents a sound fundamental theoretical knowledge of geodesy, cartography and photogrammetry, particularly as applied to hydrographic surveying, and the compilation and production of charts and maps. The course majors in one of these three fields in order to enable the graduate to perform future hydrographic duties at the Hydrographic Office, on hydrographic survey expeditions or on major fleet staffs.

### LAW (ZHC, ZHG, ZHW)

Three years (may be less depending upon educational background) of instruction for selected officers in the Law School of George Washington University, Georgetown University, or Catholic University to qualify them for the practice of law. Studies are supplemented with work in the Office of the Judge Advocate General of the U. S. Navy.

### MANAGEMENT AND INDUSTRIAL ENGINEERING (ZT)

A one-year course at Rensselaer Polytechnic Institute to prepare selected officers for managerial and executive billets in the Navy's industrial organization. The course majors in advanced production and industrial engineering as applied to managerial problems.

### NAVAL CONSTRUCTION AND ENGINEERING (ZNB)

A three-year course at Massachusetts Institute of Technology or at Webb Institute of Naval Architecture to qualify officers for naval construction and engineering assignments. Successful completion of this curriculum normally leads to "Engineering Duty" designation.

### NAVAL INTELLIGENCE (ZI)

Six months of instruction at the U. S. Naval School, Naval Intelligence, to train selected officers in all phases of intelligence. Following the intelligence course the students normally study a foreign language to qualify as an interpreter-translator. The length of time devoted to language study is dependent upon the language studied and the previous linguistic training of the student.

### NUCLEAR ENGINEERING (Advanced) (ZNE)

A fifteen-month program at the Massachusetts Institute of Technology covering applied Nuclear Physics, Reactor Technology, and other subjects pertaining to Nuclear Engineering. The students for this program are selected by the Bureau of Ships.

### OCEANOGRAPHY (ZO)

A one-year course at Scripps Institute of Oceanography to prepare officers for assignment to billets requiring specialized knowledge in the field of oceanography. Provided the student has adequate educational background, completion of the curriculum normally leads to a Master of Science degree.

## PERSONNEL ADMINISTRATION AND TRAINING (ZP)

A twelve-month course at Stanford University to prepare officers for assignment to duties involving supervision of training activities or personnel administration of large groups. The course majors in personnel psychology and sociology supported by job analysis, personnel test and measurements, record studies, personnel management, and principles of training and education. Provided the student officer has an adequate educational background, this curriculum normally leads to a Master of Science degree.

## PETROLEUM ENGINEERING (ZL)

A one-year course at the University of Pittsburgh followed by one year in industry. It prepares selected senior officers for assignment to the Munitions Board Petroleum Committee or similar billets.

## PHOTOGRAPHY (ZCR)

A two-year course at the Rochester Institute of Technology to prepare selected officers for technical duties involving photography. The curriculum includes basic courses in the materials, processes, and technical practices of photography including general chemistry, mathematics and physics, followed by specialized courses in the various photographic fields.

## RELIGION (ZU)

A one-year course which provides advanced instruction in religion and closely allied subjects for selected officers of the Chaplain Corps. Courses are of necessity individually tailored to fit the previous background and denominational training of each student. The following schools normally participate in this program:

Harvard Divinity School
Pacific School of Religion
Fordham University
Union Theological Seminary
Chicago Theological Seminary

## STRUCTURAL DYNAMICS (ZSD)

An eighteen-months' course at the University of Illinois designed primarily to provide a type of specialized professional training at the graduate level needed by some of the officers of the U. S. Navy Civil Engineering Corps and the U. S. Army Corps of Engineers to assist them in handling design problems created by the advent of atomic weapons. The emphasis is on subject matter intended to lead to a better understanding of the effects of dynamic loads on structures.

## TEXTILE ENGINEERING (ZM)

A two-year course at the Georgia Institute of Technology for selected officers of the Supply Corps which prepares them for assignment involving manufacture, procurement, storage, issue and use of textiles and clothing. Students completing this curriculum normally qualify for a Master of Science degree.

# PART IV

## CURRICULA CONDUCTED IN WHOLE OR IN PART AWAY FROM THE U. S. NAVAL POSTGRADUATE SCHOOL AT UNIVERSITIES AND OTHER INSTITUTIONS

Officials at civilian universities and other activities having cognizance of U. S. Naval Postgraduate School officer students at those activities and the U. S. Naval Postgraduate School cognizant officer in charge are listed below:

| Curriculum | Group Designator | University or Activity | Official in Charge at the Activity |
|---|---|---|---|
| (Under cognizance of Officer-in-Charge, Aerological Engineering Curricula, U. S. Naval Postgraduate School) | | | |
| Hydrographic Engineering | ZV | Ohio State Univ. | *P.N.S. |
| Oceanography | ZO | Scripps Institute of Oceanography | P.N.S., Univ. of Calif. |
| (Under cognizance of Officer-in-Charge, Aeronautical Engineering Curricula, U. S. Naval Postgraduate School) | | | |
| Armament | AR3 | M.I.T. | **CO., N.A.U., M.I.T. |
| Compressible Flow | AC3 | Calif. Institute of Tech. | P.N.S., Univ. of So. Calif. |
| Compressible Flow | AC3 | Univ. of Minnesota | P.N.S. |
| Flight Performance | AF3 | Princeton Univ. | P.N.S. |
| Gas Turbines | AT3 | Rensselaer Polytechnic Institute | P.N.S. |
| General | A3 | Univ. of Michigan | P.N.S. |
| Jet Propulsion | AJ3 | Calif. Institute of Tech. | P.N.S., Univ. of So. Calif. |
| Jet Propulsion | AJ3 | Univ. of Minnesota | P.N.S. |
| Jet Propulsion | AJ3 | Princeton Univ. | P.N.S. |
| Nuclear Engineering | AN3 | Iowa State College | P.N.S. |
| Nuclear Engineering | AN3 | Oak Ridge School of Reactor Technology | Dr. F. C. Vonderlage |
| Propulsion Systems | AP3 | M.I.T. | C.O., N.A.U., M.I.T. |
| Seaplane Hydrodynamics | AR3 | Stevens Institute of Tech.-NYU | Prof. B. K. Erdoss |
| Structures | AS3 | Calif. Institute of Tech. | P.N.S., Univ. of So. Calif. |
| Structures | AS3 | Univ. of Minnesota | P.N.S. |
| (Under cognizance of Officer-in-Charge, Naval Engineering Curricula, U. S. Naval Postgraduate School) | | | |
| Chemical Engineering | NC | Lehigh Univ. | Dean, H. A. Neville |
| Gas Turbines | NJ | M.I.T. | C.O., N.A.U., M.I.T. |
| Management and Industry | ZT | Rensselaer Polytechnic Institute | P.N.S. |
| Metallurgical Engineering | NM | Carnegie Institute of Tech. | Assoc. Prof. J. W. Ludwig |
| Naval Architecture | NR | Royal Naval College, Greenwich, England | U. S. Naval Attache, London |
| Naval Construction and Engineering | ZNB | M.I.T. | C.O., N.A.U., M.I.T. |
| Naval Construction and Engineering | ZNB | Webb Institute | Capt. N. W. Gokey, USN (Ret.) |

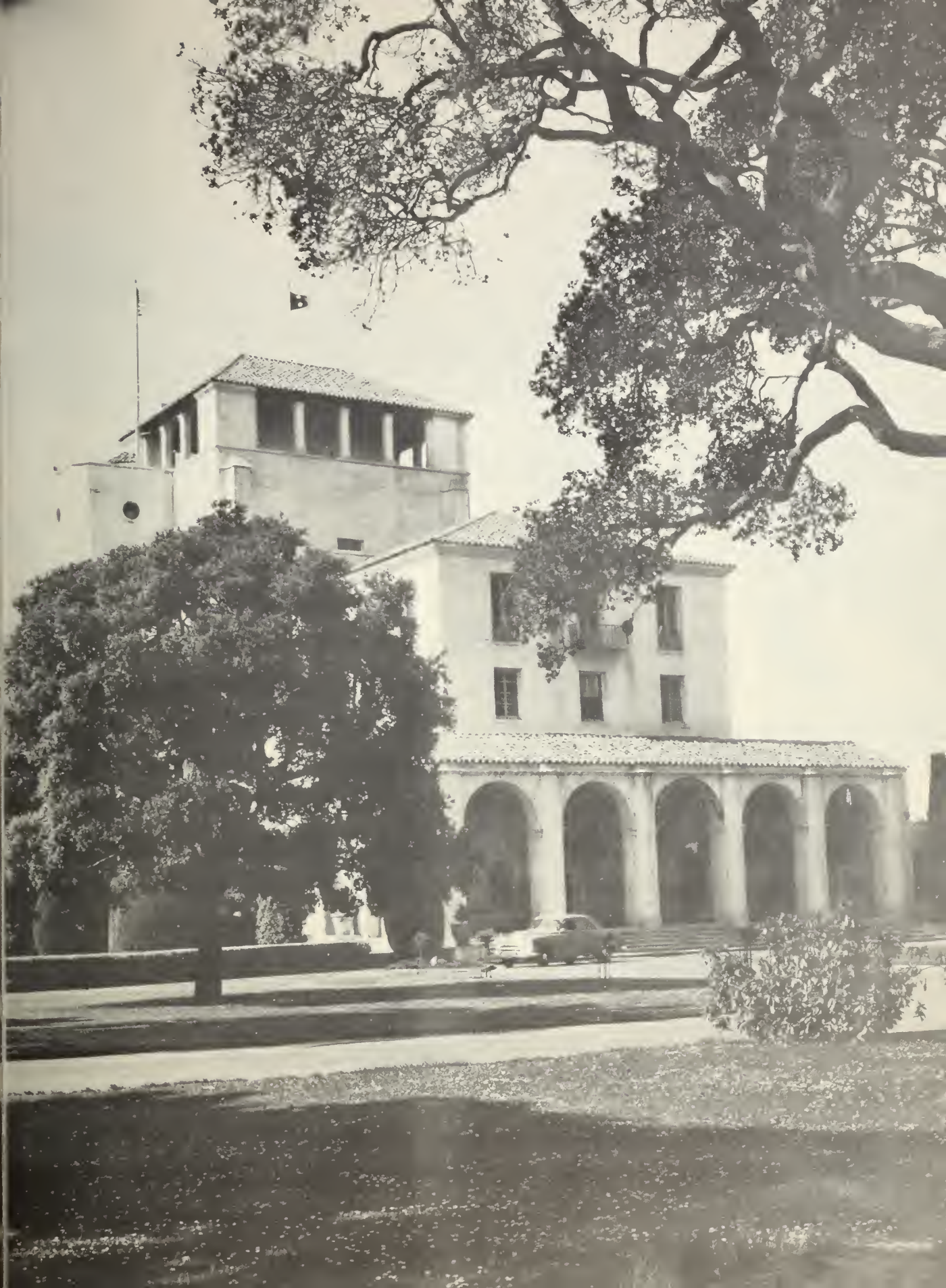
* P.N.S.—The Professor of Naval Science.

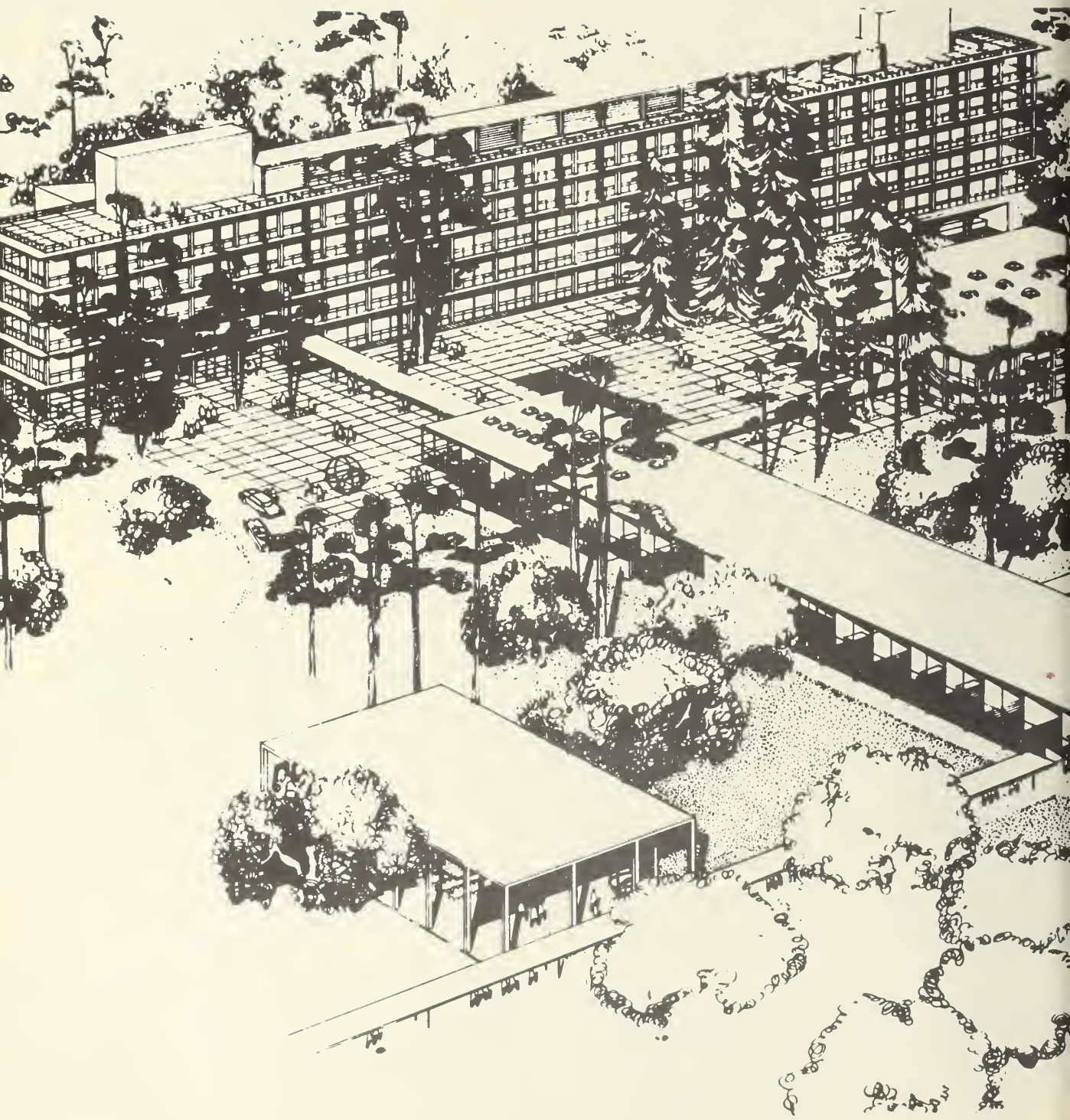
** C.O., N.A.U., M.I.T.—Commanding Officer, U. S. Naval Administrative Unit, Massachusetts Institute of Technology.

| Curriculum | Group Designator | University or Activity | Official in Charge at the Activity |
|---|---|---|---|
| Petroleum Engineering | NP | Univ. of Calif. | P.N.S. |
| Petroleum Engineering | ZL | Univ. of Pittsburgh | Prof. H. G. Botset |
| Miscellaneous | | | |
| Nuclear Engineering (Advanced) | ZNE | M.I.T. | C.O., N.A.U., M.I.T. |
| (Under cognizance of Officer-in-Charge, Ordnance Engineering Curricula, U. S. Naval Postgraduate School) | | | |
| Ordnance Engineering (Aviation) | OE | M.I.T. | C.O., N.A.U., M.I.T. |
| Ordnance Engineering (Chemical) | OP3 | Lehigh Univ. | Dean, H. A. Neville |
| Ordnance Engineering (Fire Control) | OF3 | M.I.T. | C.O., N.A.U., M.I.T. |
| Ordnance Engineering (Jet Propulsion) | OJ3 | Calif. Institute of Tech. | P.N.S., Univ. of So. Calif. |
| Miscellaneous | | | |
| Special Physics | OX2 | M.I.T. | C.O., N.A.U., M.I.T. |
| Special Physics | OX3 | M.I.T. | C.O., N.A.U., M.I.T. |
| Radiological Defense Engineering | RZ2 | Univ. of Calif. | P.N.S. |
| Radiological Defense Engineering | RZ3 | Univ. of Calif. | P.N.S. |
| Structural Dynamics | ZSD | Univ. of Illinois | P.N.S. |
| (Under cognizance of Officer-in-Charge, Miscellaneous Curricula, U. S. Naval Postgraduate School) | | | |
| Miscellaneous | | | |
| Business Administration | ZKC | Columbia Univ. | P.N.S. |
| Business Administration | ZKH | Harvard Univ. | P.N.S. |
| Business Administration | ZKS | Stanford Univ. | P.N.S. |
| Cinematography | ZCP | Univ. of So. Calif. | P.N.S. |
| Civil Engineering | ZG | Rensselaer Polytechnic Institute | P.N.S. |
| Comptrollership | ZS | George Washington Univ. | Prof. A. R. Johnson |
| Law | ZHC | Catholic Univ. | Office of the Judge Advocate General |
| Law | ZHG | Georgetown Univ. | Office of the Judge Advocate General |
| Law | ZHW | George Washington Univ. | Office of the Judge Advocate General |
| Naval Intelligence | ZI | Naval Intelligence School | Director, U. S. Naval School (Naval Intelligence) |
| Personnel Administration and Training | ZP | Stanford Univ. | P.N.S. |
| Photography | ZCR | Rochester Institute of Tech. | P.N.S. |
| Religion | ZU | Various | P.N.S. (if location permits) |
| Textile Engineering | ZM | Georgia Institute of Tech. | P.N.S. |

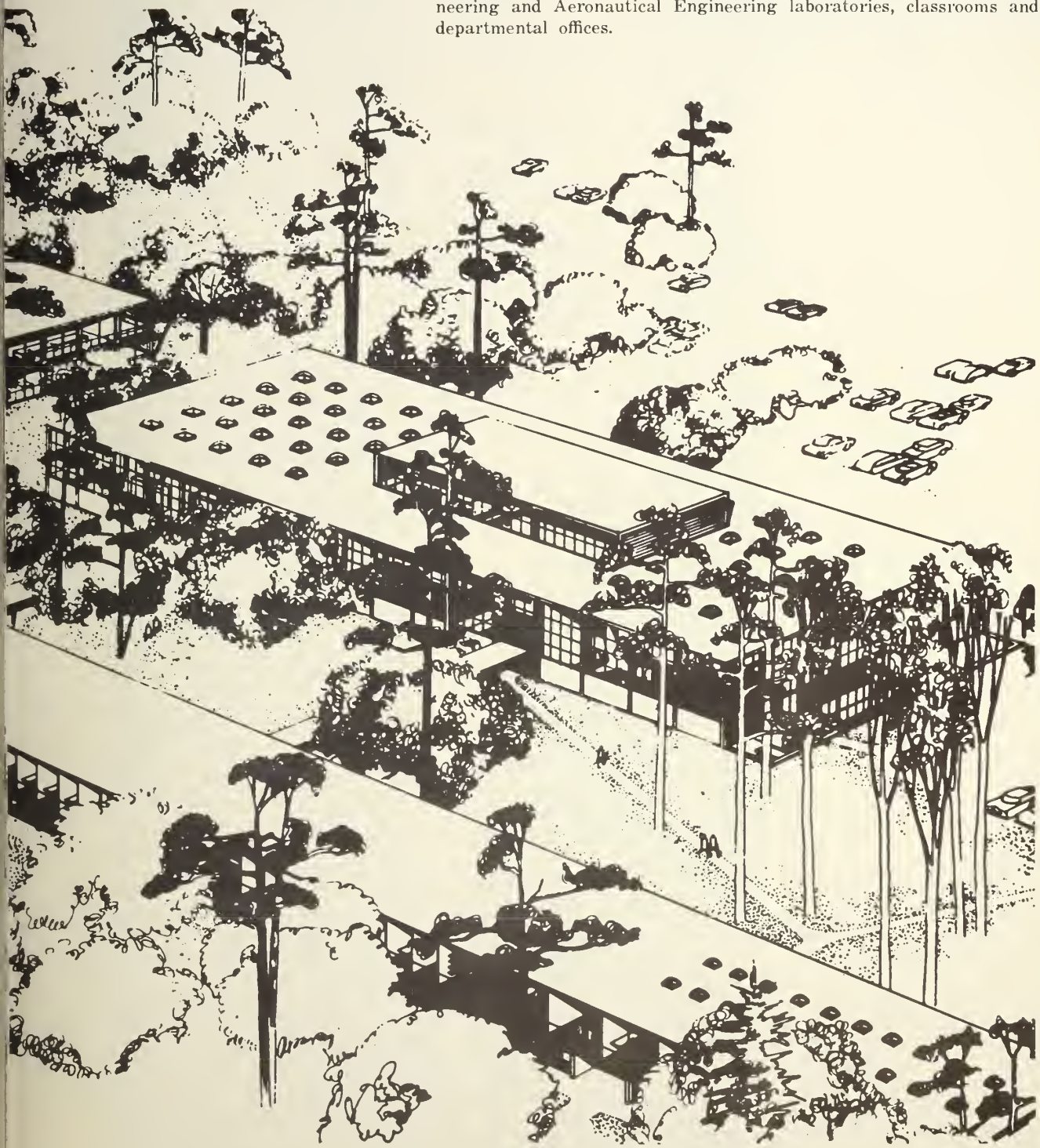
* P.N.S.—The Professor of Naval Science.

** C.O., N.A.U., M.I.T.—Commanding Officer, U. S. Naval Administrative Unit, Massachusetts Institute of Technology.





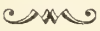
Architect's drawing of the Engineering School buildings. Construction of the five-story building which will house Electronics, Physics, Chemistry, and Metallurgy and Aerology laboratories commenced in June, 1952. The other buildings in the sketch contain Electrical Engineering Laboratory, Mathematics Department, Mechanical Engineering and Aeronautical Engineering laboratories, classrooms and departmental offices.



View of the East Wing housing some of the Engineering School classrooms, offices, and the Chemistry and Metallurgy laboratories. Swimming Pool in the foreground.

## SECTION II

# ENGINEERING SCHOOL
## of the
# U. S. NAVAL POSTGRADUATE SCHOOL



PART I GENERAL INFORMATION

1. Function of the School
2. Regulations Governing the Award of Degrees
3. Scholarship Standards
4. Military Staff
5. Civilian Faculty
6. Academic Associates
7. Designators of the Curricula Commencing at the School

PART II CURRICULA DESCRIPTIONS

PART III COURSE DESCRIPTIONS

## CALENDAR OF THE ENGINEERING SCHOOL

for

## ACADEMIC YEAR 1952—1953

### 1952

| | |
|---|---|
| Registration begins | August 14 |
| First term begins | August 18 |
| Labor Day (Holiday) | September 1 |
| First term ends | October 24 |
| Second term begins | October 28 |
| Armistice Day (Holiday) | November 12 |
| Thanksgiving Day (Holiday) | November 27 |
| Christmas leave period from (end of classes) | December 19 |

### 1953

| | |
|---|---|
| through | January 4 |
| Second term ends | January 21 |
| Third term begins | January 26 |
| Washington's Birthday (Holiday)* | February 22 |
| Third term ends | April 3 |
| Fourth term begins | April 7 |
| Memorial Day (Holiday) | May 30 |
| Fourth term ends | June 12 |
| Commencement Day | June 18 |

*Holiday observed on Monday February 23

### 1952

**JANUARY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | -- | -- |

**FEBRUARY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | -- |
| -- | -- | -- | -- | -- | -- | -- |

**MARCH**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | -- | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | -- | -- | -- | -- | -- |

**APRIL**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**MAY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

**JUNE**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**JULY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**AUGUST**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | -- | -- | -- | -- | -- | -- |

**SEPTEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | -- | -- | -- | -- |

**OCTOBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | -- |
| -- | -- | -- | -- | -- | -- | -- |

**NOVEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | -- | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | -- | -- | -- | -- | -- | -- |

**DECEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

### 1953

**JANUARY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| -- | -- | -- | -- | -- | -- | -- |

**FEBRUARY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| -- | -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**MARCH**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | -- | -- | -- | -- |

**APRIL**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**MAY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | -- | -- | -- | -- | -- | -- |

**JUNE**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**JULY**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | -- |

**AUGUST**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | -- | -- | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | -- | -- | -- | -- | -- |

**SEPTEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**OCTOBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | -- | -- | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| -- | -- | -- | -- | -- | -- | -- |

**NOVEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

**DECEMBER**

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| -- | -- | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | -- | -- |
| -- | -- | -- | -- | -- | -- | -- |

# PART I—GENERAL INFORMATION

## 1. FUNCTION OF THE SCHOOL

a. The Engineering School of the U. S. Naval Postgraduate School is established for maintaining courses of instruction for the advanced education and training of commissioned officers in such general or technical subjects as the Secretary of the Navy may prescribe.

The selection of officers applying for postgraduate instruction is made by boards appointed by the Chief of Naval Personnel. The courses available, the conditions of eligibility and other pertinent data are published annually in Bureau of Naval Personnel Circular Letters.

## 2. REGULATIONS GOVERNING THE AWARD OF DEGREES

a. As authorized by the provisions of Public Law 303, the Superintendent of the Naval Postgraduate School was authorized to confer Bachelor of Science degrees in engineering and related fields "Pursuant to such regulations as the Secretary of the Navy may prescribe—upon due accreditation—by the appropriate professional authority." On 19 December 1949, the Naval Postgraduate School was informed by the Engineers Council for Professional Development, Region IV Committee on Engineering Schools, that the following curricula were accredited: Aeronautical Engineering, Electrical Engineering (including option in Electronics), and Mechanical Engineering. On 26 April 1950, the Secretary of the Navy approved the regulations governing the award of the Bachelor of Science degree by the Naval Postgraduate School, and established the policy to limit the award of these degrees to those student officers enrolled on or subsequent to 31 July 1947.

b. The regulations governing awards of graduate degrees were approved by the Acting Secretary of the Navy on 18 July 1949. The Master's or Doctor's degrees in engineering or related fields may be awarded by the Superintendent of the Naval Postgraduate School upon the recommendation of the faculty, based upon the satisfactory completion of a course of advanced study arranged by a Curriculum Committee, approved by the Academic Council (consisting of the Academic Dean, the Director of the Engineering School, and the civilian Chairmen of the Academic Departments).

c. The regulations governing the award of Bachelor of Science degrees and graduate degrees are as follows:

(1) Requirements for the Doctor's Degree

(a) The Doctor's degree in engineering and related fields is awarded as a result of very meritorious and scholarly achievement in a particular field of study which has been approved by the Academic Council as within the purview of the Naval Postgraduate School. A candidate must exhibit faithful and scholarly application to all prescribed courses of study, achieve a high level of scientific advancement and establish his ability for independent investigation, research, and analysis. He shall further meet the requirements described in the following paragraphs.

(b) Any program approved as leading to the Doctor's degree shall require the equivalent of at least three academic years of study beyond the undergraduate level, and shall meet the needs of the Navy for advanced study in the particular area of investigation. At least one academic year of the doctorate work shall be spent at the Naval Postgraduate School.

(c) A student seeking to become a candidate for the doctorate shall hold a Bachelor's degree from a college or university, based on curriculum that included the prerequisities for full graduate status in the department of his major study, or he shall have pursued successfuly an equivalent course of study. The student shall submit his previous record to the Academic Council, via the Academic Dean, for final determination of the adequacy of his preparation.

(d) Upon favorable action by the Academic Council, the student will be notified that he may request the chairman of the department of his major subject to form a Doctorate Committee. This chairman will specify one or more minor subjects and, with the chairman of the corresponding departments, will nominate a Doctorate Committee consisting of five or more members, at least three of

whom are under different departments. The chairman of the department of the major subject will submit to the Academic Council for its approval the choice of minor fields and the names of the faculty members nominated for the Doctorate Committee.

(e) After a sufficient period of study in his major and minor fields, the student shall submit to qualifying examinations, including tests of his reading knowledge of foreign languages. The selection of these languages depends on the field of study. The minimum is a reading knowledge of German and a second language to be suggested by his Doctorate Committee and approved by the Academic Council. The language examinations will be conducted by a committee especially appointed by the Academic Council. The other qualifying examinations will cover material previously studied in his major and minor fields; they will be written and oral and will be conducted by the Doctorate Committee. The members of the Academic Council or their delegates may be present at the oral examinations. The Doctorate Committee will report the results of the qualifying examinations to the Academic Council for consideration and, upon approval, the student becomes a candidate for the Doctorate. The qualifying examinations are not given, ordinarily, before the completion of the first year of residence at the Naval Postgraduate School; they must be passed successfully at least two years before the degree is granted.

(f) Upon successful qualification as a candidate, the student will be given a further program of study by the Doctorate Committee. This program must be approved by the Academic Council.

(g) The distinct requirement of the doctorate is the successful completion of an original, significant, and scholarly investigation in the candidate's major area of study. The results of the investigation, in the form of a publishable dissertation, must be submitted to the Academic Council at least two months before the time at which it is hoped the degree will be granted. The Academic Council will select two or more referees, who will make individual written reports on the dissertation. Lastly, the Academic Council will vote upon the acceptance of the dissertation.

(h) After the approval of the dissertation, and not later than two weeks prior to the award of the degree, the candidate will be subject to written and oral examinations in his major and minor subjects. Written examinations will be conducted by the department having cognizance of the particular subject. The occasion and scope of each examination will be arranged by the Doctorate Committee, after consultation with the departments concerned and the members of the Academic Council. The Doctorate Committee will notify the Academic Council of the time of the oral examination and will invite their attendance, or that of their delegates. The committee will also invite the attendance of such other interested persons as it may deem desireable. In this oral examination, approximately one half of the allotted time will be devoted to the major subject and one half to the minor subjects. The Doctorate Committee will submit the results of all examinations to the Academic Council for their approval.

(i) With due regard for all of the above requirements, the Academic Council will decide whether to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the doctorate.

(2) Requirements for the Master's Degree

(a) The Master's degree in engineering and related fields is awarded for the successful completion of a curriculum which complements the basic scientific education of a student and which has been approved by the Academic Council as meriting a degree, provided the student exhibits superior scholarship, attains scientific proficiency, and meets additional requirements as stated in the following paragraphs.

(b) Since curricula serving the needs of the Navy ordinarily contain undergraduate as well as graduate courses, a minimum of two academic years of residence at the Naval Postgraduate School is normally required. With the approval of the Academic Council, the time of residence may be reduced in the case of particular students who have successfully pursued graduate study at other educational institutions. In no case will the degree be granted for less than one academic year of residence at the Naval Postgraduate School.

Photograph of the architect's model of the main campus of the U. S. Naval Postgraduate School showing the existing building and the new buildings to house the Engineering School and the General Line School. The shrubbery and trees are actually as shown. The new buildings are to be placed without destroying the natural beauty of the surroundings.

Aerial view of the buildings housing the interim laboratories of the Engineering School.

(c) A curriculum leading to a Master's degree shall comprise not less than 48 term hours (32 semester hours) of work that is clearly of graduate level, and shall contain a well-supported major, together with cognate minors. At least six of the term hours shall be in advanced mathematics. The proposed program shall be submitted to the cognizant department chairman for review and approval. If the program is satisfactory to the department chairman, it shall be forwarded by him to the Academic Council for final action.

(d) To become a candidate for the Master's degree the student shall have completed at least three quarters of the graduate credit courses of his curriculum with a quality point rating in them of not less than 1.75 as defined in the section on scholarship standards.

(e) To be eligible for the Master's degree, the student must attain a minimum average quality point rating of 2.0 in all graduate credit courses; 1.5 in all of his other courses. In special cases, under very extenuating circumstances, small deficiencies from the figures noted in paragraph (d) and (e) may be waived at the discretion of the Academic Council.

A reasonable proportion of the graduate work leading to the Master's degree shall be comprised of research and a thesis reporting the results obtained. The thesis topic may be selected by the student, subject to the approval of the cognizant department chairman. The completed thesis must indicate ability to perform independent work and to report on it in a scholarly fashion. The thesis, in final form, will be submitted to the cognizant department chairman for review and evaluation. Upon final approval of the thesis by the department chairman, the student shall be certified as eligible for final examination.

(g) If the thesis is accepted, the candidate for the degree shall take a final oral examination, the duration of which will be approximately one hour. An additional comprehensive written examination may be required at the discretion of the cognizant department chairman. Not more than one half of the oral examination shall be devoted to questions directly related to the candidate's thesis topic; the remainder to the candidate's major and related areas of study.

(h) With due regard for the above requirements, the Academic Council will decide whether or not to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Master's degree.

(3) Requirements for the Bachelor's Degree

(a) The Bachelor's degree in engineering or other scientific fields may be awarded for successful completion of a curriculum which serves the needs of the Navy and has the approval of the Academic Council as meriting a degree. Such a curriculum shall conform to current practice in accredited engineering institutions and shall contain a well-defined major, with appropriate cognate minors.

(b) Admission with suitable advanced standing and a minimum of two academic years of residence at the Naval Postgraduate School are normally required. With the approval of the Academic Council, this residence requirement may be reduced to not less than one academic year in the case of particular students who have had sufficient prior preparation at other institutions.

(c) To be eligible for the degree, the student must attain a minimum average quality point rating of 1.0 in all the courses of his curriculum. In very exceptional cases, small deficiencies from this figure may be waived at the discretion of the Academic Council.

(d) With due regard for the above requirements, the Academic Council will decide whether or not to recommend the candidate to the Superintendent of the Naval Postgraduate School for the award of the Bachelor's degree.

## 3. SCHOLARSHIP STANDARDS

a. Student officers enrolled in the Engineering School of the Naval Postgraduate School will be rated academically by quality points attained, and this rating shall be determined in the following manner:

| Grade | Quality Points |
|---|---|
| A | 3.0 |
| B | 2.0 |
| C | 1.0 |
| D | 0 |
| X | -1.0 |

Quality point rating shall be calculated by dividing the sum of the products of assigned quality points and credit hours in each course by the total number of credit hours obtained. Each one-hour lecture or recitation period per week, or each two-hour laboratory or practice work period, will count as one credit hour.

b. The academic level of a course is indicated by a letter in parentheses after the course number, as follows:

(A) Full graduate course

(B) Partial graduate course

(C) Undergraduate course

c. One (1) term credit-hour is given for each hour of lecture or recitation, and half of this amount for each hour of laboratory work. A term credit-hour is equivalent to two-thirds of the conventional semester credit-hour.

## 4. MILITARY STAFF

### Administrative

HAROLD DAVID KRICK, Captain, U. S. Navy
Director of the Engineering School

RICHARD ARCHIBALD MONTFORT, Lieutenant Commander, U. S. Navy
Assistant to the Director

### Aerological Engineering Curricula

GEORGE DEVEREAU GOOD, Commander, U. S. Navy
Officer-in-Charge, Aerological Engineering

J. F. O'CONNOR, Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor

WILLIAM STANLEY LANTERMAN, Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor

ROBERT EARL MOTTERN, Lieutenant Commander, U. S. Navy
Aerological Engineering Instructor

RICHARD LANE, Chief Aerographer, U. S. Navy
Aerological Engineering Instructor

### Aeronautical Engineering Curricula

EDWIN SAMUEL LEE, JR., Commander, U. S. Navy
Officer-in-Charge, Aeronautical Engineering

LOYS MALCOLM SATTERFIELD, Lieutenant Commander, U. S. Navy
Assistant to Officer-in-Charge, Aeronautical Engineering

### Communications Curricula

LELAND GRIFFITH SHAFFER, Captain, U. S. Navy
Officer-in-Charge, Communications

MILLARD JOHN SMITH, Commander, U. S. Navy
Assistant to Officer-in-Charge, Communications

ARTHUR GERNT HARRISON, Commander, U. S. Navy
Assistant to Officer-in-Charge, Communications

JAMES LOUIS MAY, Commander, U. S. Navy
Instructor in Communications

JAMES JOSEPH McMULLAN, Lieutenant Commander, U. S. Navy
Instructor in Communications

RICHARD WEBSTER HYDE, Lieutenant Commander, U. S. Navy
Instructor in Communications

ROY KENNETH HUBBARD, Lieutenant Commander, U. S. Navy
Instructor in Communications

CHARLES BISHOP WALL, Lieutenant Commander, U. S. Navy
Instructor in Communications

WILLIAM SCOTT PEASE, Lieutenant, U. S. Navy
Instructor in Communications

FRANCIS EMIL HOROBETZ, Lieutenant, U. S. Navy
Instructor in Communications

WALLEY HOWARD NOEL, Lieutenant, U. S. Navy
Instructor in Communications

**Engineering Electronics Curricula**

CHARLES MAURICE RYAN, Captain, U. S. Navy
Officer-in-Charge, Engineering Electronics

THEODORE MARION CONTE, Lieutenant Commander, U. S. Navy
Assistant to Officer-in-Charge, Engineering Electronics

ERLING WANGSNES, Lieutenant, U. S. Navy
Instructor in Engineering Electronics

**Naval Engineering Curricula**

WELLS THOMPSON, Captain, U. S. Navy
Officer-in-Charge, Naval Engineering

THEODORE HARRY BRITTAN, Commander, U. S. Navy
Assistant to Officer-in-Charge, Naval Engineering

DALE EUGENE COCHRAN, Commander, U. S. Navy
Instructor in Naval Engineering

CLAUDE CLYDE BRUBAKER, Lieutenant Commander, U. S. Navy
Instructor in Naval Engineering

**Ordnance Engineering Curricula**

WILLIAM REYNOLDS SMITH, III, Commander, U. S. Navy
Officer-in-Charge, Ordnance Engineering

FELIX LEONARD ENGLANDER, Commander, U. S. Navy
Assistant to Officer-in-Charge, Ordnance Engineering

JAMES EMMET BRENNER, JR., Commander, U. S. Navy
Instructor in Ordnance Engineering

## 5. CIVILIAN FACULTY

### Department of Aerology

WILLIAM DWIGHT DUTHIE, A.B., M.S., Ph.D.
Chairman; Professor of Aerology

GEORGE JOSEPH HALTINER, B.S., Ph.M., Ph.D.
Associate Professor of Aerology

FRANK LIONEL MARTIN, A.B., M.A., Ph.D.
Associate Professor of Aerology

JACOB BERTRAM WICKHAM, B.S., M.S.
Assistant Professor of Aerology

### Department of Aeronautics

WENDELL MAROIS COATES, A.B., M.S., D.Sc.
Chairman; Professor of Aeronautics

RICHARD WILLIAM BELL, A.B., Ae.E.
Associate Professor of Aeronautics

THEODORE HENRY GAWAIN, B.S., D.Sc.
Associate Professor of Aeronautics

RICHARD MOORE HEAD, B.S., M.S., Ae.E., Ph.D.
Professor of Aeronautics

GEORGE JUDSON HIGGINS, B.S., Ae.E.
Professor of Aeronautics

CHARLES HORACE KAHR, JR., B.S., M.S.
Associate Professor of Aeronautics

HENRY LEBRECHT KOHLER, B.S., M.S., M.E.
Professor of Aeronautics

RUDOLPH XAVER MEYER, Dipl. Ing.
Assistant Professor of Aeronautics

MICHAEL HANS VAVRA, Dipl. Ing.
Professor of Aeronautics

### Department of Electrical Engineering

CHARLES VAN ORDEN TERWILLIGER, B.Eng., M.S., D.Eng.
Chairman; Professor of Electrical Engineering

CHARLES BENJAMIN OLER, B.S., M.S., D.Eng.
Associate Professor of Electrical Engineering

ORVAL HAROLD POLK, B.S., M.S., E.E.
Professor of Electrical Engineering

CHARLES HARRY ROTHAUGE, B.Eng., D.Eng.
Associate Professor of Electrical Engineering

WILLIAM CONLEY SMITH, B.S., M.S.
Associate Professor of Electrical Engineering

WILLIAM ALFRED STEIN, B.S., M.S., D.Sc.
Assistant Professor of Electrical Engineering

GEORGE JULIUS THALER, B.Eng., D.Eng.
Assistant Professor of Electrical Engineering

ALLEN EDGAR VIVELL, B.Eng., D.Eng.
Professor of Electrical Engineering

RICHARD CARVEL HENSEN WHEELER, B.Eng., D.Eng.
Professor of Electrical Engineering

**Department of Electronics and Physics**

AUSTIN RODGERS FREY, B.S., M.S., Ph.D.
Chairman; Professor of Physics

NEAL SAMPLE ANDERSON, A.B., M.A., Ph.D.
Assistant Professor of Physics

ROBERT EDMUND BAUER, B.S., M.S.
Assistant Professor of Electronics

WILLIAM MALCOLM BAUER, B.S., E.E., M.S., D.Sc.
Professor of Electronics

JESSE GERALD CHANEY, A.B., M.A.
Professor of Electronics

RODERICK KEENER CLAYTON, B.S., Ph.D.
Associate Professor of Physics

WILLIAM PEYTON CUNNINGHAM, B.S., Ph.D.
Professor of Physics

PAUL EUGENE COOPER, B.S., M.S.
Associate Professor of Electronics

JOHN JAMES DOWNING, JR., B.S.
Instructor of Electronics

GEORGE ROBERT GIET, A.B., E.E.
Professor of Electronics

EARL GASCOIGNE GODDARD, B.S., M.A., E.E.
Assistant Professor of Electronics

ROBERT KAHAL, B.E.E., M.E.E., O.Eng.
Associate Professor of Electronics

SYDNEY HOBART KALMBACH, B.S., M.S.
Assistant Professor of Physics

LAWRENCE EDWARD KINSLER, B.S., Ph.D.
Professor of Physics

CLARENCE FREDERICK KLAMM, B.S., M.S.
Assistant Professor of Electronics

WILLIAM WARNER LANG, JR., B.S., M.S.
Instructor of Physics

CARL ERNEST MENNEKEN, B.S., M.S., (on leave)
Professor of Electronics

ROBERT LEE MILLER, B.Ed., M.S.
Associate Professor of Electronics

NORMAN LEE OLESON, B.S., M.S., Ph.D.
Associate Professor of Physics

WILLIAM HENRY ROADSTRUM, B.S., M.S.
Assistant Professor of Electronics

ABRAHAM SHEINGOLD, B.S., M.S.
Associate Professor of Electronics

DONALD ALAN STENTZ, B.S.
Assistant Professor of Electrical Engineering

MICHAEL SATOSHI WATANABE, B.S., D.Sc.
Professor of Physics

**Department of Mathematics and Mechanics**

WARREN RANDOLPH CHURCH, A.B., M.A., Ph.D.
Chairman; Professor of Mathematics and Mechanics

WILLARD EVAN BLEICK, M.E., Ph.D.
Professor of Mathematics and Mechanics

RICHARD CROWLEY CAMPBELL, B.S., M.A.
Associate Professor of Mathematics and Mechanics

FRANK DAVID FAULKNER, B.S., M.S.
Associate Professor of Mathematics and Mechanics

JOSEPH GIARRATANA, B.S., Ph.D.
Professor of Mathematics and Mechanics

WALTER JENNINGS, A.B., B.S., M.A.
Associate Professor of Mathematics and Mechanics

BROOKS JAVINS LOCKHART, A.B., M.S., Ph.D.
Associate Professor of Mathematics and Mechanics

ALADUKE BOYD MEWBORN, B.S., M.S., Ph.D.
Professor of Mathematics and Mechanics

THOMAS EDMUND OBERBECK, A.B., M.A., Ph.D.
Associate Professor of Mathematics and Mechanics

FRANCIS McCONNEL PULLIAM, A.B., M.A., Ph.D.
Associate Professor of Mathematics and Mechanics

CHARLES HENRY RAWLINS, JR., Ph.B., M.A., Ph.D.
Professor of Mathematics and Mechanics

CHARLES CHAPMAN TORRANCE, M.E., M.A., Ph.D.
Professor of Mathematics and Mechanics

**Department of Mechanical Engineering**

PAUL JAMES KIEFER, A.B., B.S., M.E.
Chairman; Senior Professor of Mechanical Engineering

EUGENE ELIAS DRUCKER, B.S., M.S.
Assistant Professor of Mechanical Engineering

ERNEST KENNETH GATCOMBE, B.S., M.S., Ph.D.
Professor of Mechanical Engineering

DENNIS KAVANAUGH, B.S.
Professor of Mechanical Engineering

ROBERT EUGENE NEWTON, B.S., M.S., Ph.D.
Professor of Mechanical Engineering

ROY WALTERS PROWELL, B.S., M.S.
Associate Professor of Mechanical Engineering

ALLEN KLEIBER SCHLEICHER, B.S., M.S.
Instructor of Mechanical Engineering

IVAR HOWARD STOCKEL, B.S., M.S.
Instructor of Mechanical Engineering

HAROLD MARSHALL WRIGHT, B.S., M.M.E.
Professor of Mechanical Engineering

**Department of Metallurgy and Chemistry**

FREDERICK LEO COONAN, A.B., M.S., D.Sc.
Chairman; Professor of Metallurgy and Chemistry

NEWTON WEBER BUERGER, B.S., M.S., Ph.D.
Professor of Metallurgy

JOHN ROBERT CLARK, B.S., D.Sc.
Associate Professor of Metallurgy

GEORGE JOSEPH DANEK, JR., B.S.
Instructor of Chemistry

CARL ADOLPH HERING, B.S., M.S.
Associate Professor of Chemical Engineering

GILBERT FORD KINNEY, A.B., M.S., Ph.D.
Professor of Chemical Engineering

LLOYD RANDALL KOENIG, B.S.
Instructor of Chemical Engineering

GEORGE DANIEL MARSHALL, JR., B.S.. M.S.
Associate Professor of Metallurgy

GEORGE HAROLD McFARLIN, A.B., M.A.
Associate Professor of Chemistry

MELVIN FERGUSON REYNOLDS, B.S., M.S., Ph.D.
Professor of Chemistry

JAMES EDWARD SINCLAIR, B.S.
Assistant Professor of Chemistry

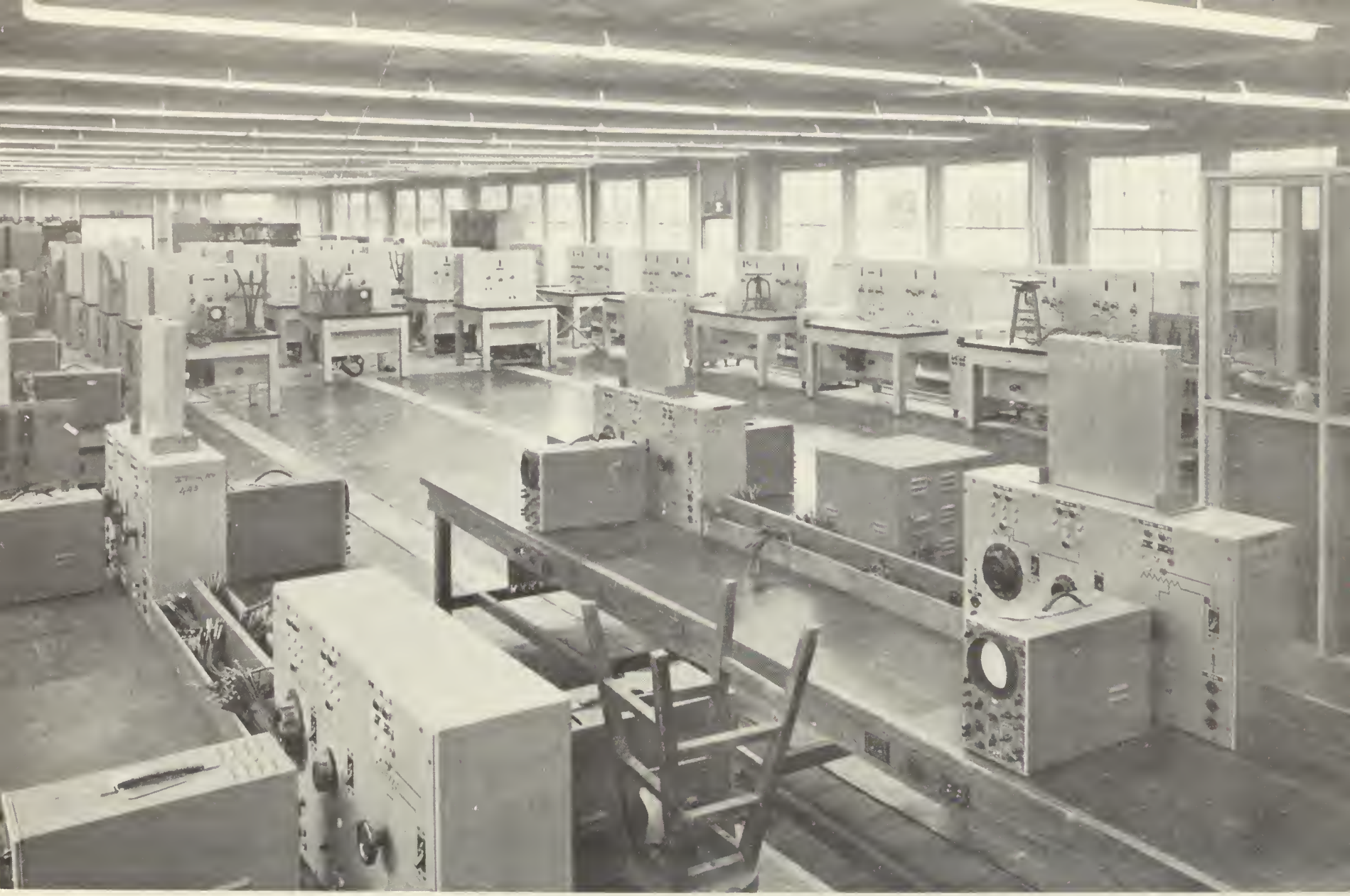
JAMES WOODROW WILSON, A.B., B.S., M.S.
Associate Professor of Chemical Engineering

## 6. ACADEMIC ASSOCIATES

A member of the civilian faculty is appointed as Academic Associate for each curriculum to advise the Officer-in-Charge of the Curriculum with regard to academic matters and to be jointly responsible with him for the formulation of the curriculum and the presentation of subjects.

| Curricula | Groups | Academic Associates |
|---|---|---|
| Advanced Science | RM | WARREN RANDOLPH CHURCH, Professor of Mathematics and Mechanics |
| | RX | AUSTIN ROGERS FREY, Professor of Physics |
| | RC | GILBERT FORD KINNEY, Professor of Chemical Engineering |
| Aerological Engineering | M, MW, MS, MA | WILLIAM DWIGHT DUTHIE, Professor of Aerology |
| Aeronautical Engineering | A, A2, AC3, AF3, AH3, AJ3, AP3, AS3, AE | WENDELL MAROIS COATES, Professor of Aeronautics<br>ALLEN EDGAR VIVELL, Professor of Electrical Engineering<br>RICHARD CARVEL HENSEN WHEELER, Professor of Electrical Engineering |
| Communications | C | GEORGE ROBERT GIET, Professor of Electronics |
| Electronics Engineering | E | GEORGE ROBERT GIET, Professor of Electronics |
| General Line School | | FRANK EMILIO LaCAUZA, Professor of Electrical Engineering |
| Naval Engineering | NM, NP | FREDERICK LEO COONAN, Professor of Metallurgy and Chemistry |
| | NC | GILBERT FORD KINNEY, Professor of Chemical Engineering |
| | NL, NJ | ORVAL HAROLD POLK, Professor of Electrical Engineering |
| | NQ, NA, NH | HAROLD MARSHALL WRIGHT, Professor of Mechanical Engineering |
| Nuclear Engineering (Effects)<br>Structural Dynamics | RZ<br>ZSD | AUSTIN ROGERS FREY, Professor of Physics |
| Operations Engineering | RO | WILLIAM PEYTON CUNNINGHAM, Professor of Physics |
| Ordnance Engineering | OM | FREDERICK LEO COONAN, Professor of Metallurgy and Chemistry |
| | OX | AUSTIN ROGERS FREY, Professor of Physics |
| | OP | GILBERT FORD KINNEY, Professor of Chemical Engineering |
| | O, OE, Oj | RICHARD CARVEL HENSEN WHEELER, Professor of Electrical Engineering |
| Radiological Defense Engineering | RZ, AN3 | AUSTIN ROGERS FREY, Professor of Physics |

Entrance to the interim Physics Laboratory and Electrical Engineering Laboratory. Radar Tower in the background.



Interim Electrical Engineering Laboratory.

## 7. CURRICULA OF THE ENGINEERING SCHOOL

All curricula given at or commencing at the Engineering School of the U. S. Naval Postgraduate School are shown below. The numeral "2" in the group designator denotes the second year of instruction and, similarly, the numeral "3" denotes the third year.

| Curricula Under Cognizance of Officer in Charge of | Length of Course | Group Designator |
|---|---|---|
| AEROLOGICAL ENGINEERING | | |
| Aerological Engineering | 18 mos. | MA, MA2 |
| Advinced Aerological Engineering | 18 mos. | MS, MS2 |
| AERONAUTICAL ENGINEERING | | |
| Aeronautical Engineering | 2 yrs., 3 yrs.* | A, AG, A2 |
| *Note: Third year of specialization at a civilian university as follows: | | |
| General | Univ. of Michigan | A3 |
| Compressible Flow | Calif. Institute of Tech.<br>Univ. of Minnesota | AC3 |
| Flight Performance | Princeton Univ. | AF3 |
| Seaplane Hydrodynamics | Stevens Institute of Tech.—NYU | AH3 |
| Jet Propulsion | Calif. Institute of Tech.<br>Univ. of Minnesota<br>Princeton Univ. | AJ3 |
| Nuclear Engineering | Iowa State College<br>Oak Ridge School of Reactor Technology | AN3 |
| Propulsion Systems | Mass. Institute of Tech. | AP3 |
| Structures | Calif. Institute of Tech.<br>Univ. of Minnesota | AS3 |
| Gas Turbines | Rensselaer Polytechnic Institute | AT3 |
| Aeronautical Engineering Electrical | 2 yrs., 3 yrs. | AE, AE2, AE3 |
| Aeronautical Engineering Armament | 2 yrs., 3 yrs.* | AR, AR2 |
| *Note: Third year of specialization at | Mass. Institute of Tech. | AR3 |
| COMMUNICATIONS | | |
| Communications | 1 yr. | C |
| Communication Officers Short Course | 12 wks. | CS |
| ENGINEERING ELECTRONICS | | |
| Engineering Electronics | 2 yrs., 3 yrs.* | E, E2, EA2, E3 |
| *Note: Sonar students have third year of specialization at | Univ. of Calif. at L.A. | EW3 |
| Advanced Science | | |
| Chemistry | 3 yrs.* | RC, RC2, RC3 |
| Mathematics | 3 yrs. | RM, RM2, RM3 |
| Physics | 3 yrs. | RX, RX2, RX3 |
| *Note: Second and third years at selected universities. | | |

| Curricula Under Cognizance of Officer in Charge of | Length of Course | Group Designator |
|---|---|---|
| NAVAL ENGINEERING | | |
| Chemical Engineering | 2 yrs., 3 yrs.* | NC, NC2 |
| *Note: Third year of specialization for certain qualified students at a selected university. | | NC3 |
| Electrical Engineering | | |
| Basic Curriculum | 2 yrs. | NL, NL2 |
| Advanced Curriculum | 3 yrs.* | NL, NLA2, NL3 |
| *Note: Given to certain qualified students selected at end of first year of basic curriculum. | | |
| Gas Turbines | 3 yrs.* | NJ, NJ2 |
| *Note. Third year of specialization at a selected university. | | NJ3 |
| Mechanical Engineering | | |
| Basic Curriculum | 2 yrs. | NH, NH2 |
| Advanced Curriculum | 3 yrs.* | |
| *Note: Given to certain qualified students selected at end of first year of basic curriculum. | | NH, NHA2, NH3 |
| Mechanical Engineering (Equilization) | 2 yrs. | NQ, NQ2 |
| Metallurgical Engineering | | |
| Basic Curriculum | 2 yrs., 3 yrs.* | NM, NM2 |
| *Note: Third year of specialization for certain qualified students at a selected university. | | NM3 |
| Petroleum Engineering | | |
| Basic Curriculum | 3 yrs.* | NP, NP2, NP3 |
| *Note: Second and third years at selected civilian universities. | | |
| ORDNANCE ENGINEERING | | |
| Ordnance Engineering (General) | 2 yrs., 3 yrs.* | O, O2, OF2 |
| *Note: Third year of specialization in Fire Control at Massachusetts Institute of Technology for selected students. | | OF3 |
| Aviation | 2 yrs., 3 yrs.* | OE, OE2 |
| *Note: Third year of specialization at Massachusetts Institute of Technology for selected students. | | OE3 |
| Chemical | 3 yrs.* | OP, OP2 |
| *Note: Third year of specialization at a selected university. | | OP2 |

| Curricula Under Cognizance of Officer in Charge of | Length of Course | Group Designator |
|---|---|---|
| Jet Propulsion<br>*Note: Third year of specialization at Calif. Institute of Technology. | 3 yrs.* | OJ, OJ2<br>OJ3 |
| Special Physics<br>*Note: Second and third years of specialization at Massachusetts Institute of Technology. | 3 yrs.* | OX, OX2, OX3 |
| Nuclear Engineering (Effects)<br>(Commences with class entering August 1952) | 2 yrs. | RZ, RZ2 |
| Radiological Defense<br>(Ends with class graduating June 1954) | 3 yrs. | RZ2, RZ3 |
| Operations Analysis<br>*Note: Field work during last 6 mos. under direction of Chief of Naval Operation. | 2 yrs.* | RO, RO2 |

# PART II

## CURRICULA FOR THE ENGINEERING SCHOOL COMPONENT OF THE U. S. NAVAL POSTGRADUATE SCHOOL

All instruction is given at the School, Monterey, California, except where otherwise noted.

For each course, the short title, the academic level, the descriptive name, the classroom, and laboratory hours per week are set forth.

Example: Ma-101(C) Introduction to Engineering Mathematics 4-0

Detailed course descriptions are set forth in Part III.

# AEROLOGICAL ENGINEERING CURRICULUM

## MA—GROUP

### OBJECTIVE

To prepare officers to become qualified aerologists, with a working knowledge of oceanography as applied to naval operations.

### FIRST YEAR—MA

#### First Term

| | | |
|---|---|---|
| Ma-161 | (C) Algebra, Trigonometry, and Analytic Geometry | 5-0 |
| Mr-200 | (C) Introduction to Synoptic Meteorology | 3-0 |
| Mr-201 | (C) Weather Maps and Codes | 2-9 |
| Ph-190 | (C) Surveys of Physics I | 3-0 |
| | | 13-9 |

#### Second Term

| | | |
|---|---|---|
| Ma-162 | (C) Introduction to Calculus | 5-0 |
| Mr-202 | (C) Surface Weather Map Analysis | 2-9 |
| Mr-601 | (C) Introduction to Oceanography | 2-1 |
| Ph-191 | (C) Survey of Physics II | 3-0 |
| | | 12-10 |

#### Third Term

| | | |
|---|---|---|
| Ma-163 | (C) Calculus and Vector Analysis | 5-0 |
| Mr-203 | (C) Weather Analysis and Forecasting | 2-12 |
| Mr-301 | (C) Synoptic Meteorology I | 4-0 |
| Mr-402 | (C) Meteorological Charts and Diagrams | 3-0 |
| *SL-101 | New Weapons Development I (Lecture) | 0-1 |
| | | 14-13 |

#### Fourth Term

| | | |
|---|---|---|
| Ma-361 | (C) Statistics | 4-2 |
| Mr-204 | (C) Upper Air Analysis and Forecasting | 2-12 |
| Mr-302 | (C) Synoptic Meteorology II | 4-0 |
| Mr-510 | (C) Climatology | 2-0 |
| Mr-602 | (C) Physical Oceanography | 2-0 |
| *SL-102 | New Weapons Development II (Lecture) | 0-1 |
| | | 14-15 |

*Lecture course—no academic credit.

Intersessional Field Trip

### SECOND YEAR—MA2

#### First Term

| | | |
|---|---|---|
| Mr-215 | (B) Advanced Weather Analysis and Forecasting | 0-12 |
| Mr-303 | (C) Synoptic Meteorology III | 4-0 |
| Mr-403 | (C) Physical Meteorology | 4-0 |
| Mr-410 | (C) Meterological Instruments | 2-2 |
| Mr-610 | (B) Wave, Swell and Surf Forecasting | 2-2 |
| | | 12-16 |

#### Second Term

| | | |
|---|---|---|
| Mr-110 | (C) Radiological Defense | 2-0 |
| Mr-216 | (B) Advanced Weather Analysis and Forecasting | 0-12 |
| Mr-217 | (B) Upper Air Analysis and Forecasting | 0-8 |
| Mr-603 | (C) Naval Applications of Oceanography | 4-2 |
| | | 6-22 |

# ADVANCED AEROLOGICAL ENGINEERING CURRICULUM

MS—GROUP

## OBJECTIVE

To provide opportunity for selected aerological officers who have completed a previous aerology curriculum and have served approximately three years in aerological billets:

(a) To acquire the necessary theoretical and practical training for advanced work in the field of meteorology.

(b) To acquire a working knowledge of the latest advances in meteorology and related subjects.

(c) To acquire a working knowledge of oceanography as applied to naval operations.

## FIRST YEAR—MS

### First Term

| | | |
|---|---|---|
| Ma-131 | (C) Algebraic Equations and Series | 3-0 |
| Ma-132 | (C) Topics in Engineering Mathematics | 5-0 |
| Mr-611 | (B) General Oceanography | 3-1 |
| Ph-196 | (C) Review of General Physics | 5-0 |
| | | 16-1 |

### Second Term

| | | |
|---|---|---|
| Ma-103 | (B) Functions of Several Variables and Vector Analysis | 5-0 |
| Mr-411 | (B) Thermodynamics of Meteorology | 5-2 |
| Mr-412 | (A) Physical Meteorology | 3-0 |
| Mr-613 | (C) Applied Oceanography (Underwater Sound) | 2-1 |
| | | 15-3 |

### Third Term

| | | |
|---|---|---|
| Ma-134 | (B) Vector Mechanics and Introduction to Statistics | 5-0 |
| Mr-226 | (B) Advanced Weather Analysis and Forecasting | 2-9 |
| Mr-220 | (B) Selected Topics in Meteorology | 4-0 |
| Mr-321 | (A) Dynamic Meteorology I | 3-0 |
| *SL-101 | New Weapons Development I (Lecture) | 0-1 |
| | | 14-10 |

### Fourth Term

| | | |
|---|---|---|
| Ma-331 | (A) Statistics | 4-2 |
| Mr-227 | (B) Upper Air Analysis and Forecasting | 2-9 |
| Mr-322 | (A) Dynamic Meteorology II | 3-0 |
| Mr-323 | (A) Dynamic Meteorology III (Turbulence and Diffusion) | 3-0 |
| Mr-614 | (C) Military Oceanography | 2-2 |
| *SL-102 | New Weapons Development II (Lecture) | 0-1 |
| | | 14-14 |

*Lecture course—no academic credit.

Thesis preparation during Intersessional Field Trip period (six weeks).

## SECOND YEAR—MS2

### First Term

| | | |
|---|---|---|
| Ma-135 | (B) Partial Differential Equations and Numerical Methods | 4-0 |
| Mr-422 | (A) The Upper Atmosphere | 5-0 |
| Mr-520 | (B) Applied Climatology | 2-0 |
| Mr-921 | (A) Thesis I | 2-6 |
| | | 13-6 |

### Second Term

| | | |
|---|---|---|
| *Mr-110 | (C) Radiological Defense | 2-0 |
| *Mr-610 | (B) Wave, Swell and Surf Forecasting | 2-2 |
| Mr-230 | (A) Operational Forecasting | 0-10 |
| Mr-810 | (A) Seminar | 2-0 |
| Mr-922 | (A) Thesis II | 4-0 |
| | | 10-12 |

*Only for students who have not already completed courses in these subjects.

Successful completion of the above curriculum normally leads to the award of the Master of Science degree.

# AERONAUTICAL ENGINEERING CURRICULA

## OBJECTIVE

The general objective of the aeronautical engineering curricula is to provide officers with advanced aeronautical engineering knowledge to meet the technical requirements of the Navy in this field. Specifically, these curricula are designed to cover the fundamental and advanced theories of mathematics, mechanics, metallurgy, structural analysis, aerodynamics, dynamics, and aircraft propulsion, electricity, and electronics as they concern the particular curriculum.

## AERONAUTICAL ENGINEERING, GENERAL

These curricula consist of two years of study at the Naval Postgraduate School, the last year of which includes a performance and flight test program. Qualified volunteers will be selected at the end of the fifth term to take the three-year curricula, the last year of which is spent at a civilian engineering school. Curricula for the third year at the various civilian institutions are arranged to provide emphasis on such fields as aircraft structural analysis, aircraft propulsion systems, compressibility, hydrodynamics and seaplane design, pilotless aircraft, aircraft performance, and nuclear engineering as well as general aeronautical engineering. Satisfactory completion of any three-year curriculum normally leads to the award of a graduate degree in aeronautical engineering.

## FIRST YEAR (A) GROUPS

### First Term

| | | |
|---|---|---|
| Ma-100 | (C) Vector Algebra and Geometry | 2-0 |
| Ma-111 | (C) Introduction to Engineering Mathematics | 3-0 |
| Mc-101 | (C) Engineering Mechanics I | 3-0 |
| Ae-200 | (C) Rigid Body Statics of Aircraft | 3-2 |
| Ch-121 | (B) General and Petroleum Chemistry | 4-2 |
| Mt-201 | (C) Introductory Physical Metallurgy | 3-2 |
| | | 18-6 |

### Second Term

| | | |
|---|---|---|
| Ma-112 | (B) Differential Equations and Boundary Value Problems | 4-0 |
| Mc-102 | (C) Engineering Mechanics II | 3-0 |
| Ae-211 | (C) Stress Analysis I | 4-0 |
| Ae-100 | (C) Basic Aerodynamics | 3-4 |
| Mt-202 | (C) Ferrous Metals | 3-2 |
| Me-601 | (C) Materials Testing Laboratory | 0-2 |
| *Ae-001 | Aeronautical Lecture | 0-1 |
| | | 17-9 |

### Third Term

| | | |
|---|---|---|
| Ma-113 | (B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ae-212 | (C) Stress Analysis II | 4-2 |
| Ae-121 | (C) Technical Aerodynamics | 3-2 |
| Mt-203 | (B) Physical Metallurgy | 2-2 |
| Ma-201 | (C) Graphical and Mechanical Computation | 0-2 |
| EE-111 | (C) Fundamentals of Electrical Engineering | 3-2 |
| *SL-101 | New Weapons Development I (Lecture) | 0-1 |
| | | 15-11 |

### Fourth Term

| | | |
|---|---|---|
| Ma-114 | (A) Partial Differential Equations and Functions of a Complex Variable | 3-0 |
| Ae-213 | (B) Stress Analysis III | 4-2 |
| Ae-131 | (C) Aerodynamic Performance | 4-2 |
| ME-131 | (C) Engineering Thermodynamics | 4-2 |
| EE-351 | (C) DC Machinery | 2-2 |
| *SL-102 | New Weapons Development II (Lecture) | 0-1 |
| | | 17-9 |

*Lecture course—no academic credit.

Note: Approximately six weeks of June and July, 1953, Intersessional Period, will be spent in the field at aviation activities.

## SECOND YEAR (AG2) GROUP, TWO-YEAR COURSE

### First Term

| | |
|---|---|
| Ae-311 (C) Airplane Design I | 2-4 |
| Ae-132 (B) Flight Analysis | 3-2 |
| Ae-410 (B) Thermodynamics (Aeronautical) | 3-2 |
| Ae-501 (A) Hydro-Aero-Mechanics I | 4-0 |
| EE-241 (C) AC Circuits | 3-2 |
| *IE-101 (C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 15-11 |

### Second Term

| | |
|---|---|
| Ae-141 (A) Aircraft Dynamics I | 3-4 |
| Ae-411 (B) Aircraft Engines | 4-2 |
| Ae-502 (A) Hydro-Aero-Mechanics II | 4-0 |
| EE-711 (C) Electronics | 3-2 |
| Ae-151 (B) Aeronautical Seminar | 2-0 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 16-9 |

### Third Term

| | |
|---|---|
| Ae-142 (A) Aircraft Dynamics II | 3-4 |
| Ae-421 (B) Aircraft Propulsion | 3-2 |
| Ae-503 (A) Compressibility | 4-0 |
| EE-611 (B) Servomechanisms | 3-4 |
| Ae-152 (B) Aeronautical Seminar | 2-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103 (C) Applied Industrial Organization (Lecture) | 0-1 |
| | 15-12 |

### Fourth Term

Flight program emphasizing performance and test.

This program may be coordinated with academic schedules to cover the last three terms.

*Lecture course—no academic credit.

If practicable, a summer period will be spent in a civilian institution summer course in industrial engineering before reporting to new duty station.

## SECOND YEAR (A2) GROUPS, THREE-YEAR COURSE

### First Term

| | |
|---|---|
| Ae-311 (C) Airplane Design I | 2-4 |
| Ae-132 (B) Flight Analysis | 3-2 |
| Ae-410 (B) Thermodynamics (Aeronautical) | 3-2 |
| Ae-501 (A) Hydro-Aero-Mechanics I | 4-0 |
| EE-241 (C) AC Circuits | 3-2 |
| *IE-101 (C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 15-11 |

### Second Term

| | |
|---|---|
| Ae-141 (A) Aircraft Dynamics I | 3-4 |
| Ae-411 (B) Aircraft Engines | 4-2 |
| Ae-502 (A) Hydro-Aero-Mechanics II | 4-0 |
| Ae-214 (A) Stress Analysis IV | 3-0 |
| Ae-302 (B) Airplane Design II | 1-4 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 15-11 |

### Third Term

| | |
|---|---|
| Ae-142 (A) Aircraft Dynamics II | 3-4 |
| Ae-421 (B) Aircraft Propulsion | 3-2 |
| Ae-503 (A) Compressibility I | 4-0 |
| **Ch-521 (A) Chemistry of Plastics | 3-2 |
| Ma-116 (A) Matrices and Numerical Methods | 4-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103 (C) Applied Industrial Organization (Lecture) | 0-1 |
| | 17-10 |

### Fourth Term

| | |
|---|---|
| Ae-431 (A) Internal Flow in Aircraft Engines | 4-0 |
| Ae-215 (A) Advanced Stress Analysis | 4-0 |
| Ae-504 (A) Compressibility II | 3-2 |
| Mc-311 (A) Vibrations | 3-2 |
| **ME-632 (B) Experimental Stress Analysis | 2-2 |
| *IE-104 (C) Human Engineering | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-8 |

*Lecture course—no academic credit.

**Propulsion group takes Ch-561(A) Physical Chemistry (3-2) and Flight Performance group takes Ma-118(A) in place of ME-632(B) 4th term. Nuclear Engineering group takes Atomic Physics, Ph-640(B) (3-3) in place of ME-632(B) 4th term, and Quantative Analysis, Ch-231(C) (2-4) in place of Ch-521(A) 3rd term.

Summer period spent in a civilian institution summer course in industrial engineering. Third and last year aeronautical engineering will be conducted by a civilian institution.

## THIRD YEAR CURRICULA

### Aeronautical Engineering, General

### THIRD YEAR (A3) AT THE UNIVERSITY OF MICHIGAN

Fall Term

Ae-116 Advanced Fluid Dynamics
Ae-172 Instrumentation and Research
*Ae-118 Experimental Aerodynamics
*Ae-174 Atomic Physics
*Ae-105 Dynamic Stability
*EM-123 Theory of Strength
*MA-152 Mathematics—Fourier Series
*Ae-133 Advanced Airplane Structures
*Ae-250 Theory of Non-linear Oscillations
Ae-162 Thesis

*Elective courses.

Spring Term

*Ae-102 Advanced Design
Ae-160-2 Symposium-Propulsion
Ae-162 Thesis
*Ae-165 Aircraft Propulsion I
*Ae-171 Aircraft Servo Control Systems
*Ae-202 Dynamics of Compressible Fluids
*Ae-203 Dynamics of Perfect Fluids
*Ae-204 Aircraft Propulsion II
*EM-129 Plasticity

*Elective courses.

### Aeronautical Engineering, Compressible Flow

### THIRD YEAR (AC3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

| | | | |
|---|---|---|---|
| AE-260 Research in Aeronautics | 16 | 16 | 16 |
| AE-261 Hydrodynamics of Compressible Fluids | 9 | 9 | 9 |
| AE-266 Theoretical Aerodynamics of Real And Perfect Fluids | 9 | 9 | 9 |
| AE-270 Elasticity Applied to Aeronautics | 6 | 6 | 6 |
| AE-272 Precision Measurements | 3 | 3 | 3 |
| AE-290 Aeronautics Seminar | 1 | 1 | 1 |
| AM-150 Vibration and Flutter Problems | 6 | 6 | 6 |
| | 50 | 50 | 50 |

### THIRD YEAR (AC3) AT UNIVERSITY OF MINNESOTA

Fall Term

*Ae-116 Advanced Airplane Stresses ---------- 3
**Ae-201 Aerodynamics of Compressible Flow -- 3
Ae-220 High Speed Performance and Design --- 3
Ae-280 Thesis

Winter Term

Ae-117 Advanced Airplane Stresses ---------- 3
Ae-202 Compressible Fluids ---------- 3
Ae-203 High Speed Performance and Design ---- 3
Ae-280 Thesis

Spring Term

Ae-119 Structural Test of Aircraft ---------- 3
Ae-204 Supersonic Aerodynamics Laboratory --- 3
ME-253 Advanced Gas Turbines ---------- 3
Ae-280 Thesis (total for 3 terms) ---------- 20

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

In case transfer credit is granted for either or both of these subjects, they will not be taken and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

### Aeronautical Engineering, Aircraft Flight Performance

### THIRD YEAR (AF3) AT PRINCETON UNIVERSITY

Fall Term

EE-316(a) Electronics
AE-565 Airplane Dynamics
AE-567 Helicopter Analysis
AE-583 Advanced Airplane Performance
Thesis

Spring Term

AE-566 Airplane Dynamics
AE-568 Helicopter Analysis
EE-528 Servomechanisms
Thesis
Plus one elective.

### Aeronautical Engineering, Seaplane Hydrodynamics

THIRD YEAR (AH3) AT STEVENS INSTITUTE OF TECHNOLOGY AND NEW YORK UNIVERSITY

Fall Term

FD-203 Mechanics of Fluid Resistance
FD-204 Hydrodynamic Theory
FD-215 Seaplane Design I
*FD 217 Marine and Aircraft Propulsion I
*FD-213 Special Problems, Fluid Dynamics I
*MA-517 Ordinary and Partial Differential Equations
*MA-519 Advanced Calculus I
*AE-206 Applied Elasticity
AE-209 Advanced Stress Analysis
Thesis

Spring Term

FD-210 Experimental Mathematics in Hydrodynamics
FD-211 Mechanics of Bodies in Fluids
FD-216 Seaplane Design II
*FD-218 Marine and Aircraft Propulsion II
*FD-214 Special Problems, Fluid Dynamics II
*MA-520 Advanced Calculus II
*AE-117 Aircraft Structural Laboratory
AE-210 Aircraft Stress Analysis
Thesis

*Elective courses.

### Aeronautical Engineering, Jet Propulsion

THIRD YEAR (AJ3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

| | | | |
|---|---|---|---|
| AE-261 Hydrodynamics of Compressible Fluids | 9 | 9 | 9 |
| AE-272 Precision Measurements | 3 | 3 | 3 |
| AE-290 Aeronautics Seminar | 1 | 1 | 1 |
| JP-121 Rockets | 12 | — | — |
| JP-130 Thermal Jets | — | 12 | 12 |
| JP-170 Jet Propulsion Laboratory | 3 | 3 | 3 |
| JP-200 Chemistry Problems in Jet Propulsion | 6 | 6 | 6 |
| JP-280 Research in Jet Propulsion | 16 | 16 | 16 |
| | 50 | 50 | 50 |

THIRD YEAR (AJ3) AT UNIVERSITY OF MINNESOTA

Fall Term

*AE-116 Advanced Airplane Stresses — 3
**AE-201 Aerodynamics of Compressible Fluids — 3
ME-252 Advanced Reciprocating Engines — 3
Thesis

Winter Term

AE-117 Advanced Airplane Stresses — 3
AE-202 Compressible Fluids — 3
ME-253 Advanced Gas Turbines — 3
Thesis

Spring Term

AE-119 Structural Test of Aircraft — 3
AE-204 Supersonic Aerodynamics Laboratory — 3
ME-255 Thermal Jets and Rockets — 3
Thesis (total for 3 terms) — 20

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better may apply for transfer credit.

In case transfer credit is granted for either or both of these subjects, they will not be taken and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

THIRD YEAR (AJ3) AT PRINCETON UNIVERSITY

Fall Term

AE-563 Jet Propulsion
AE-581 Gas Dynamics
AE-587 Rockets
AE-589 Fluid Friction and Heat Transfer
Thesis

Spring Term

AE-564 Jet Propulsion
AE-582 Gas Dynamics
AE-589 Fluid Friction and Heat Transfer
AE-586 Combustion Problems in Jet Propulsion, or, Mechanical Aspects of Jet Engines
Thesis

### Aeronautical Engineering, Nuclear Engineering

### THIRD YEAR (AN3) AT IOWA STATE COLLEGE

#### Fall Term

| | |
|---|---|
| Engg.-501 Elements of Nuclear Engineering | 3 |
| Engg.-620 Seminar | 1 |
| Lib.-614 Bibliographical Research | 1 |
| Phys.-435 Nuclear Physics for Engineers | 3 |
| *ME-325 Heat Transfer | 3 |
| Chem.-529 Radiochemistry | 3 |
| Engg.-600 Research | 1 |
| | 15 |

#### Winter Term

| | |
|---|---|
| Engg.-502 Reactor Materials and Structures | 3 |
| Phys.-346 Nuclear Physics for Engineers | 3 |
| Chem.-529 Radiochemistry | 2 |
| **Engg.-600 Research | 7 |
| | 15 |

#### Spring Term

| | |
|---|---|
| Engg.-503 Reactor Fuels and Wastes | 3 |
| Engg.-504 Reactor Design | 3 |
| Engg.-600 Research | 9 |
| | 15 |

*Technical elective to be substituted if candidate has credit in ME-325.

**Physics-422 (Quantum Mechanics) may be substituted for 3 credits of Engg.-600.

### THIRD YEAR (AN3) AT OAK RIDGE SCHOOL OF REACTOR TECHNOLOGY

| | |
|---|---|
| Reactor Chemistry | 36 hours |
| Nuclear Physics | 36 or 72 hours |
| Reactor Theory | 186 hours |
| Experimental Reactor Physics | 90 hours |
| Metallurgy and Ceramics | 72 hours |
| Engineering | 36 or 72 hours |
| Reactor Engineering | 72 hours |
| Reactor Design Problem or Component Development Research | 500 hours |

### Aeronautical Engineering, Aircraft Propulsion Systems

### THIRD YEAR (AP3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

#### Fall Term

| | |
|---|---|
| 2.213 Gas Turbines | 3- 0-9 |
| 2.791 Internal Combustion Engines | 3- 0-6 |
| 10.70 Combustible Principles | 3- 0-6 |
| 16.105 Applied Aerodynamics | 3- 0-6 |
| Thesis | 0-10-0 |
| | 49 |

#### Spring Term

| | |
|---|---|
| 2.212 Advanced Mechanics | 3- 0-9 |
| 2.792 Internal Combustion Engines | 3- 0-6 |
| 16.56 Jet Propulsion Engines | 3- 0-9 |
| Thesis | 0-15-0 |
| | 48 |

### Aeronautical Engineering, Structures

### THIRD YEAR (AS3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

| | | | |
|---|---|---|---|
| AE-254 Advanced Problems in Airplane Design | 6 | 6 | 6 |
| AE-260 Research in Aeronautics | 16 | 16 | 16 |
| AE-265 Advanced Problems in Aerodynamics | 6 | 6 | 6 |
| AE-270 Elasticity Applied to Aeronautics | 6 | 6 | 6 |
| AE-272 Precision Measurement | 3 | 3 | 3 |
| AE-274 Aeroelasticity | 6 | 6 | 6 |
| AE-290 Aeronautics Seminar | 1 | 1 | 1 |
| AM-150 Vibration and Flutter Problems | 6 | 6 | 6 |
| | 50 | 50 | 50 |

## THIRD YEAR (AS3) AT UNIVERSITY OF MINNESOTA

### Fall Term

| | |
|---|---|
| *Ae-116 Advanced Airplane Stresses | 3 |
| **Ae-201 Aerodynamics of Compressible Fluids | 3 |
| Ae-240 Dynamics of Airplane Structures | 3 |
| AE-280 Thesis | |

### Winter Term

| | |
|---|---|
| Ae-117 Advanced Airplane Stresses | 3 |
| Ae-202 Compressible Fluids | 3 |
| Ae-241 Dynamics of Aircraft | 3 |
| Ae-280 Thesis | 3 |

### Spring Term

| | |
|---|---|
| Ae-118 Stresses in Aircraft Structures | 3 |
| Ae-204 Supersonic Aerodynamics Laboratory | 3 |
| Ae-119 Structural Test of Aircraft | 3 |
| Ae-280 Thesis (total for 3 terms) | 20 |

*Candidates who have taken Ae-213(B), Stress Analysis, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

**Candidates who have taken Ae-503(A), Compressibility, at the U. S. Naval Postgraduate School, and received a grade of B or better, may apply for transfer credit.

In case transfer credit is granted for either or both of these subjects, they will not be taken, and course Ae-204, Supersonic Aerodynamics Laboratory, will be taken in the Fall Term in order to leave the Spring Term more free for thesis work.

**Aeronautical Engineering, Gas Turbine Propulsion Systems**

## THIRD YEAR (AT3) AT RENSSELAER POLYTECHNIC INSTITUTE

### Fall Term

G1.17 Compressible and Incompressible Flow
G12.30 Thermodynamics of High Velocity Flow
G12.40 Gas Turbine Combustion and Stability
G4.52 Chemistry of Hydrocarbon Fuels and of Combustion
G13.62 Metallurgy of High Temperature Alloys

### Spring Term

G12.41 Turbines and Jets Cycles
G1.13 Dynamics and Stability of Aircraft
G16.67 Nuclear Physics
G12.99 Thesis

## AERONAUTICAL ENGINEERING, ARMAMENT

This curriculum consists of two years of study at the Postgraduate School. Selected students will continue for a third year of study at the Massachusetts Institute of Technology. Satisfactory completion of the three-year curriculum normally leads to the award of a graduate degree. This curriculum is designed to cover electrical, aeronautical, and mechanical engineering subjects and related mathematics, metallurgy, electronics, and ordnance courses. The third year at Massachusetts Institute of Technology majors in guided missile electronics controls and fire control systems.

## FIRST YEAR (AR) GROUP

### First Term

| | |
|---|---|
| EE-151(C) DC Circuits and Fields | 3-4 |
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-111(C) Introduction to Engineering Mathematics | 3-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ae-200(C) Rigid Body Statics of Aircraft | 3-2 |
| Ch-101(C) General Inorganic Chemistry | 3-2 |
| | 17-8 |

### Second Term

| | |
|---|---|
| EE-251(C) AC Circuits | 3-4 |
| Ma-112(B) Differential Equations and Boundary Value Problems | 4-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ae-211(C) Stress Analysis I | 4-0 |
| Ae-100(C) Basic Aerodynamics | 3-4 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 17-9 |

Third Term

| | |
|---|---|
| EE-451(C) Transformers and Synchros | 2-2 |
| Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Ae-212(C) Stress Analysis II | 4-2 |
| Ae-121(C) Technical Aerodynamics | 3-2 |
| Ma-201(C) Graphical and Mechanical Computation | 0-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 15-11 |

Fourth Term

| | |
|---|---|
| EE-455(C) Asynchronous Motors | 2-2 |
| Ma-114(A) Partial Differential Equations and Functions of a Complex Variable | 3-0 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| Ae-213(B) Stress Analysis III | 4-2 |
| Ae-136(B) Aircraft Performance | 3-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 15-9 |

*Lecture course—no academic credit.

Six weeks intersessional period in the field.

## SECOND YEAR (AR2) GROUP

First Term

| | |
|---|---|
| Ma-105(A) Fourier Series and Boundary Value Problems | 4-0 |
| Ae-501(A) Hydro-Aero-Mechanics I | 4-0 |
| Ae-311(C) Aircraft Design | 2-4 |
| EE-551(B) Transmission Lines and Filters | 3-2 |
| EE-751(C) Electronics | 3-4 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 16-11 |

Second Term

| | |
|---|---|
| Ma-106(A) Complex Variable and Laplace Transform | 4-0 |
| Ma-401(A) Mechanical Computers | 2-2 |
| Mc-201(A) Methods in Dynamics | 2-2 |
| Ae-502(A) Hydro-Aero-Mechanics II | 4-0 |
| EE-755(A) Electronic Control and Measurement | 3-4 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 15-9 |

Third Term

| | |
|---|---|
| EE-671(A) Transients | 3-4 |
| Mc-401(A) Exterior Ballistics | 3-0 |
| Or-141(C) Guided Missiles Guidance | 2-0 |
| Ae-503(A) Compressibility | 4-0 |
| Ae-146(C) Aircraft Dynamics | 3-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 15-8 |

Fourth Term

| | |
|---|---|
| EE-753(C) Electronics | 1-2 |
| EE-662(A) Servomechanisms | 3-3 |
| Es-456(C) Introduction to Radar (Airborne) | 2-2 |
| Mt-203(B) Physical Metallurgy | 2-2 |
| Mc-402(A) Dynamics of Missiles and Gyros | 3-0 |
| Or-142(C) Guided Missiles Guidance | 2-0 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 13-11 |

*Lecture course—no academic credit.

Summer period will be spent in a civilian institution summer course in industrial engineering.

## THIRD YEAR (AR3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Fall Term

| | |
|---|---|
| 16.18 Guided Missiles | 3- 0-6 |
| 16.39T Vector Kinematics and Gyroscopic Instrument Theory | 3- 0-6 |
| 16.15 Advanced Stability and Control of Aircraft | 3- 0-6 |
| 16.41 Fire Control Principles | 3- 0-6 |
| 16.43 Fire Control Instrument Laboratory | 0- 3-6 |
| Thesis | 0- 6-0 |
| | 51 |

Spring Term

| | |
|---|---|
| 16.42 Fire Control Systems | 3- 0-9 |
| 16.44T Advanced Fire Control Instruments Laboratory | 0- 3-6 |
| 16.40T Automatic Control Equipment for Aircraft | 3- 0-6 |
| Thesis | 0-20-0 |
| | 50 |

## AERONAUTICAL ENGINEERING, ELECTRICAL

This curriculum consists of two years of study at the Naval Postgraduate School. Selected students will continue for a third year of study at the Naval Postgraduate School. Satisfactory completion of the three-year curriculum normally leads to the award of a graduate degree in electrical engineering. This curriculum is designed to provide major emphasis on electricity and is supported by aeronautics, mathematics, metallurgy, electronics, and mechanics. The objective of this curriculum is to provide electrical engineers who will have a good understanding of aeronautical engineering.

### FIRST YEAR (AE) GROUP

#### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-111(C) Introduction to Engineering Mathematics | 3-0 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| Mc-100(C) Engineering Mechanics I | 3-0 |
| Ae-200(C) Rigid Body Statics of Aircraft | 3-2 |
| Ch-101(C) General Inorganic Chemistry | 3-2 |
| | 17-8 |

#### Second Term

| | |
|---|---|
| Ma-112(B) Differential Equations and Boundary Value Problems | 4-0 |
| EE-271(C) AC Circuits | 3-2 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ae-211(C) Stress Analysis I | 4-0 |
| Ae-100(C) Basic Aerodynamics | 3-4 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 17-7 |

#### Third Term

| | |
|---|---|
| Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| EE-272(C) AC Circuits | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Ae-212(C) Stress Analysis II | 4-2 |
| Ae-121(C) Technical Aerodynamics I | 3-2 |
| Ma-201(C) Graphical and Mechanical Computation | 0-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 15-11 |

#### Fourth Term

| | |
|---|---|
| Ma-114(A) Partial Differential Equations and Functions of a Complex Variable | 3-0 |
| EE-371(C) DC Machinery | 3-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| Ae-213(B) Stress Analysis III | 4-2 |
| Ae-136(B) Aircraft Performance | 3-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-9 |

*Lecture course—no academic credit.

Six weeks intersessional period in the field at an aviation test activity.

### SECOND YEAR (AE2) GROUP

#### First Term

| | |
|---|---|
| Ma-105(A) Fourier Series and Boundary Value Problems | 4-0 |
| EE-471(C) Transformers, Asynchronous Machines, and Synchros | 3-4 |
| Ae-311(C) Aircraft Design | 2-4 |
| Ae-501(A) Hydro-Aero-Mechanics I | 4-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 13-9 |

#### Second Term

| | |
|---|---|
| Ma-106(A) Complex Variable and Laplace Transform | 4-0 |
| EE-472(C) Synchronous Machines | 3-4 |
| EE-971(A) Seminar | 1-0 |
| Mc-201(A) Methods in Dynamics | 2-2 |
| Ae-502(A) Hydro-Aero-Mechanics II | 4-0 |
| *Ae-001 Aeronautical Lecture | 0-1 |
| | 14-7 |

#### Third Term

| | |
|---|---|
| EE-571(B) Transmission Lines and Filters | 3-4 |
| EE-771(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| Es-256(C) Introduction to Radar Applications of Vacuum Tubes | 2-0 |
| Ae-503(A) Compressibility | 4-0 |
| Ae-146(A) Aircraft Dynamics | 3-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 16-10 |

Fourth Term

| | |
|---|---|
| EE-772(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| Es-226(A) Pulse Circuits | 2-1 |
| Mt-203(B) Physical Metallurgy | 2-2 |
| Ch-521(A) Plastics | 3-2 |
| *IE-104(C) Industrial Organization (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| **Elective | |
| | 11-9 |

*Lecture course—no academic credit.

**Elective courses may be selected from advanced courses in the Aeronautical Engineering Department or the Electrical Engineering Department or other departments in the Postgraduate School, subject to the needs of the individual student.

Intersessional period of six weeks in an electrical test activity.

## THIRD YEAR (AE3) GROUP

First Term

| | |
|---|---|
| EE-671(A) Transients | 3-4 |
| EE-871(A) Electrical Machine Design | 4-0 |
| Es-431(B) Radar System Engineering | 3-3 |
| Thesis | 0-6 |
| | 10-13 |

Second Term

| | |
|---|---|
| EE-662(A) Servomechanisms | 3-3 |
| EE-872(A) Electrical Machine Design | 4-0 |
| EE-971(A) Seminar | 1-0 |
| Es-432(B) Radar System Engineering | 3-6 |
| Thesis | 0-3 |
| | 11-12 |

Third Term

| | |
|---|---|
| Es-321(B) Radio Systems | 3-3 |
| EE-873(A) Electrical Machine Design | 4-0 |
| EE-971(A) Seminar | 1-0 |
| Thesis | 0-10 |
| | 8-13 |

Fourth Term

| | |
|---|---|
| EE-874(A) Electrical Machine Design | 4-0 |
| EE-971(A) Seminar | 1-0 |
| Es-536(B) Counter Measures | 2-3 |
| Thesis | 0-10 |
| | 7-13 |

# COMMUNICATIONS CURRICULUM

## C—GROUP

### OBJECTIVE

To prepare selected officers for communications, operational and staff duties; and to better fit them for command duties. This curriculum majors in practical communications, operations, tactics, and elementary electronics. Students are required to enroll in the Naval War College correspondence course in Strategy and Tactics.

First Term

| | | |
|---|---|---|
| Co-101(C) | Typing and Radio Code | 0-4 |
| Co-110(C) | Radio and Visual Procedure | 2-2 |
| Co-120(C) | Communication Security and Registered Publication Handling | 2-1 |
| Co-131(C) | Tactics | 2-2 |
| Co-135(C) | Correspondence Course in Strategy and Tactics | —— |
| Es-186(C) | Fundamentals of Radio Communications | 4-4 |
| Es-281(C) | Electronic Fundamentals | 2-2 |
| | | 12-15 |

Second Term

| | | |
|---|---|---|
| Co-102(C) | Radio Code and Wireless Telegraph Procedure | 0-3 |
| Co-111(C) | Tape Relay and Toll Traffic Procedure | 2-1 |
| Co-121(C) | Communication Planning | 2-1 |
| Co-132(C) | Tactics | 2-2 |
| Co-135(C) | Correspondence Course in Strategy and Tactics | —— |
| Es-282(C) | Vacuum Tube Circuits | 4-4 |
| Es-786(C) | RF Energy Transmission | 3-2 |
| | | 13-13 |

Third Term

| | | |
|---|---|---|
| Co-103(C) | Visual and Voice Procedure | 1-3 |
| Co-112(C) | International and Commercial Communications | 1-1 |
| Co-122(C) | Communication Planning | 2-2 |
| Co-133(C) | Tactics | 2-2 |
| Co-135(C) | Correspondence Course in Strategy and Tactics | —— |
| Es-283(C) | Vacuum Tube Circuits | 4-3 |
| Es-286(C) | Pulsing and High-Frequency Circuits | 3-2 |
| *SL-101 | New Weapons Development I (Lecture) | 0-1 |
| | | 13-14 |

Fourth Term

| | | |
|---|---|---|
| Co-104(C) | Military Communication Organizations | 1-1 |
| Co-113(C) | Correspondence and Mail | 1-1 |
| Co-114(C) | Cryptosystems | 0-3 |
| Co-123(C) | Communication Planning | 1-2 |
| Co-134(C) | Tactics | 2-2 |
| Co-135(C) | Correspondence Course in Strategy and Tactics | —— |
| Es-386(C) | Transmitters and Receivers | 3-3 |
| Es-586(C) | Special Systems | 3-3 |
| *SL-102 | New Weapons Development II (Lecture) | 0-1 |
| | | 11-16 |

*Lecture course—no academic credit.

# COMMUNICATION OFFICERS SHORT COURSE CURRICULUM

## CS—GROUP

### OBJECTIVE

To educate officers in the operational aspects of communications and to qualify them for positions of responsibility in the communications organization afloat. Graduates are qualified to serve as communication officers of auxiliary types and destroyers or as assistant communication officers of large ships and staffs. This curriculum extends over a period of 12 academic weeks and sections will convene during fiscal 1953 on the following dates:

4 August 1952
29 September 1952
24 November 1952
19 January 1953
16 March 1953
11 May 1953

The hours listed for courses which comprise this curriculum are total hours.

| | | |
|---|---|---|
| Co-150(C) | Communication Procedures | 80 hours |
| Co-151(C) | Security | 32 hours |
| Co-152(C) | Cryptography | 34 hours |
| Co-153(C) | Communication Plans | 62 hours |
| Co-154(C) | Miscellaneous Communication Subjects | 20 hours |
| Co-155(C) | Typing, Radiotelegraph Code, and Radiotelephone Operating | 32 hours |
| Co-160(C) | Tactics | 76 hours |
| | Total classroom hours | 336 hours |

# ENGINEERING ELECTRONICS CURRICULA

## OBJECTIVE

To give the student a thorough practical and theoretical training in engineering electronics in preparation for future duties involving the development and use of electronics equipment and systems in the Naval Establishment.

## THREE-YEAR CURRICULUM

(Presented at graduate level)

### FIRST YEAR (E)

#### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-101(C) Introduction to Engineering Mathematics | 3-0 |
| Es-111(C) DC Electricity | 4-4 |
| Es-211(C) Electron Tubes and Circuits | 2-3 |
| Ph-211(C) Optics | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 14-8 |

#### Second Term

| | |
|---|---|
| Ma-102(C) Differential Equations and Series | 5-0 |
| Es-112(C) AC Electricity | 4-3 |
| Es-212(C) Electron Tubes and Circuits | 2-3 |
| Ph-212(B) Physical Optics and Introductory Dynamics | 3-3 |
| | 14-9 |

#### Third Term

| | |
|---|---|
| Ma-103(B) Functions of Several Variables and Vector Analysis | 5-0 |
| Es-113(C) Circuit Analysis and Measurements | 3-3 |
| Es-213(C) Electron Tubes and Circuits | 4-3 |
| Ph-113(B) Dynamics | 3-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 15-8 |

#### Fourth Term

| | |
|---|---|
| Ma-104(A) Partial Differential Equations and Related Topics | 5-0 |
| Es-114(C) Circuit Analysis and Measurements | 3-3 |
| Es-214(C) Electron Tubes and Circuits | 4-3 |
| Ph-311(B) Electrostatics and Magnetostatics | 3-0 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| | 15-8 |

*Lecture course—no academic credit.

### SECOND YEAR (E2)

#### First Term

| | |
|---|---|
| Es-621(A) Electromagnetics | 3-0 |
| EE-314(C) DC and AC Machinery | 3-4 |
| Ph-421(A) Fundamental Acoustics | 3-0 |
| Es-225(A) Electron Tubes | 3-6 |
| | 12-10 |

#### Second Term

| | |
|---|---|
| Es-121(A) Advanced Circuit Theory | 3-2 |
| Es-622(A) Electromagnetics | 4-0 |
| Ph-422(A) Applied Acoustics | 3-0 |
| Es-126(C) Radio Frequency Measurements | 2-6 |
| | 12-8 |

#### Third Term

| | |
|---|---|
| Es-623(A) Electromagnetics | 4-0 |
| Es-122(A) Advanced Circuit Theory | 3-2 |
| Ph-423(A) Underwater Acoustics | 2-3 |
| Es-321(B) Radio Systems | 3-3 |
| | 12-8 |

#### Fourth Term

| | |
|---|---|
| Es-624(A) Electromagnetics | 3-0 |
| Es-123(A) Advanced Circuit Theory | 3-0 |
| Es-226(A) Ultra-High-Frequency Tubes | 4-3 |
| Es-322(B) Radio Systems | 3-3 |
| | 13-6 |

## THIRD YEAR (E3)

### First Term

| | |
|---|---|
| Es-736(B) Antennas, Transmission Lines | 3-3 |
| Es-134(A) Advanced Circuit Theory | 3-0 |
| Es-431(B) Radar System Engineering | 3-3 |
| Es-333(B) Radio Systems | 2-3 |
| | 11-9 |

### Second Term

| | |
|---|---|
| EE-672(A) Servomechanisms | 3-3 |
| Es-531(B) Special Systems | 3-3 |
| Es-432(B) Radar System Engineering | 3-6 |
| Es-831(A) Thesis | 2-0 |
| | 11-12 |

### Third Term

This term is spent in an industrial electronics laboratory, such as Bell Telephone Laboratories, R.C.A., or General Electric Company. During this period the student works as a junior engineer or physicist on a selected project which forms part of, or is related to, his thesis.

### Fourth Term

| | |
|---|---|
| Es-532(B) Special Systems | 3-3 |
| Es-036(C) Electronics Administration | 2-0 |
| Es-832(A) Thesis Seminar | 4-0 |
| Es-836(A) Project Seminar | 1-0 |
| Ph-631(B) Atomic Physics | 4-0 |
| | 14-3 |

## TWO-YEAR CURRICULUM

(Presented at undergraduate level)

## FIRST YEAR (E)

Follow First Year (E) of three-year curriculum

## SECOND YEAR (EA2)

### First Term

| | |
|---|---|
| Es-227(C) Ultra-High-Frequency Tubes | 3-2 |
| Es-326(B) Radio Systems | 3-3 |
| EE-314(C) DC and AC Machinery | 3-4 |
| Ph-427(B) Fundamental and Applied Acoustics | 4-0 |
| | 13-9 |

### Second Term

| | |
|---|---|
| Es-327(B) Radio Systems | 4-3 |
| Es-126(C) Radio Frequency Measurements | 2-6 |
| Es-421(B) Radar Fundamentals | 2-3 |
| Ph-428(B) Underwater Acoustics | 2-3 |
| | 10-15 |

### Third Term

| | |
|---|---|
| Es-328(B) Radio Systems | 2-3 |
| Es-422(B) Radar System Engineering | 3-3 |
| Es-721(B) Antennas and Wave Propagation | 3-3 |
| Es-521(B) Special Systems | 3-3 |
| | 11-12 |

### Fourth Term

| | |
|---|---|
| Es-423(B) Radar System Engineering | 3-6 |
| Es-722(B) Antennas and Wave Propagation | 3-3 |
| Es-522(B) Special Systems | 3-3 |
| Es-036(C) Electronics Administration | 2-0 |
| | 11-12 |

# ENGINEERING ELECTRONICS (SONAR)

## OBJECTIVE

To give the student a thorough practical and theoretical training in engineering electronics and acoustics in preparation for future duties involving the development and use of underwater electronics equipment and systems in the Naval Establishment.

## FIRST YEAR (E)

Follow first year (E) of three-year curriculum

## SECOND YEAR (E2)

Follow second year (E2) of three-year curriculum except substitute Ph-424(A) Sonar Systems and Developments for Es-322(B) Radio Systems.

## THIRD YEAR (EW3) AT UNIVERSITY OF CALIFORNIA AT LOS ANGELES

| Fall Semester | Spring Semester |
|---|---|
| Phys 214 Advanced Acoustics | Phys 266 Propagation of Waves in Fluids |
| Phys 220A Theoretical Mechanics | Phys 264 Advanced Acoustics Seminar |
| Phys 114C Acoustics Laboratory | Phys 290 Acoustics Research |
| Phys 124 Nuclear Structure | Phys 117 Hydrodynamics |
| | Phys 119 Kinetic Theory |

# NAVAL ENGINEERING CURRICULA

The Naval Engineering curricula includes the following:

Chemical Engineering
Electrical Engineering
Gas Turbines
Mechanical Engineering
Mechanical Engineering (Equalization)
Metallurgical Engineering
Petroleum Engineering

## CHEMICAL ENGINEERING

### OBJECTIVE

The objective of this curriculum is to prepare a small group of officers in advanced chemical engineering, for technical and administrative duties in connection with the following:

(a) Research and development in the Navy, involving materials other than metals, for naval use.

(b) Bureau of Ships activities involving chemical engineering principles.

(c) Liaison with civilian establishments in the development, production, and utilization of materials for the naval service.

### FIRST YEAR (NC)

First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-111(C) Introduction to Engineering Mathematics | 3-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-6 |

Second Term

| | |
|---|---|
| Ma-112(B) Differential Equations and Boundary Value Problems | 4-0 |
| EE-251(C) AC Circuits | 3-4 |
| Ch-221(C) Qualitative Analysis | 3-2 |
| Ge-101(C) Physical Geology | 3-0 |
| Ge-241(C) Geology of Petroleum | 2-2 |
| | 15-8 |

Third Term

| | |
|---|---|
| Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ch-231(C) Quantitative Analysis | 2-3 |
| Ch-411(C) Physical Chemistry | 3-2 |
| Ch-311(C) Organic Chemistry | 3-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Cr-311(B) Crystallography and Mineralogy | 3-2 |
| | 17-11 |

Fourth Term

| | |
|---|---|
| Ch-521(A) Plastics | 3-2 |
| Ch-611(C) Thermodynamics | 3-2 |
| Ch-312(C) Organic Chemistry | 3-2 |
| Ch-412(C) Physical Chemistry | 3-2 |
| Ge-302(C) Determinative Mineralogy | 1-4 |
| | 13-12 |

Intersessional Field Trip; summer leave period.

### SECOND YEAR (NC-2)

First Term

| | |
|---|---|
| Ch-541(A) Reaction Motors | 2-2 |
| Ch-612(C) Thermodynamics | 3-2 |
| ME-500(C) Strength of Materials | 3-0 |
| Me-601(C) Materials Testing Laboratory | 0-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 11-9 |

Second Term

| | |
|---|---|
| Ch-413(A) Physical Chemistry Advanced | 2-2 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| EE-751(C) Electronics | 3-4 |
| ME-421(C) Hydromechanics | 3-2 |
| ME-711(C) Mechanics of Machines | 3-2 |
| | 13-12 |

Third Term

| | |
|---|---|
| Ch-701(C) Chemical Engineering Calculations | 3-2 |
| Ch-321(A) Organic Qualitative Analysis | 2-2 |
| Ch-323(A) Chemistry of High Polymers | 3-0 |
| ME-422(B) Hydromechanics | 2-2 |
| Ph-610(B) Atomic Physics | 3-0 |
| *IE-103(C) Industrial Engineering (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 13-8 |

Fourth Term

| | |
|---|---|
| Ma-301(B) Statistics | 3-2 |
| Ch-800(A) Chemistry Seminar | 2-0 |
| Ch-322(A) Organic Chemistry Advanced | 3-2 |
| Mt-301(A) High Temperature Materials | 3-0 |
| ME-310(B) Heat Transmission | 3-2 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 14-8 |

Intersessional Field Trip for students selected for a third year; summer leave period.

*Lecture course—no academic credit.

## THIRD YEAR (NC-3)

At a civilian university. Subjects generally similar to the following:

Advanced Physical Chemistry
Chemical Engineering Thermodynamics
Management Policies
Chemical Engineering
Theory of Errors

Students attending the civilian university will receive a degree of Master of Science from the university provided they meet the requirements in subject matter, grades, and thesis.

# ELECTRICAL ENGINEERING CURRICULA

## OBJECTIVE

The objective of these curricula is to prepare officers in advanced electrical engineering, for technical and administrative duties ashore and afloat, involving research, development, design and inspection of naval machinery and engineering plants.

### Basic Curriculum (two years)

Designed to supply, to maximum extent possible in two years, broad coverage in a variety of subjects essential to understanding of modern naval engineering, with emphasis on electrical engineering.

## FIRST YEAR (NL)

### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-101(C) Introduction to Engineering Mathematics | 3-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-6 |

### Second Term

| | |
|---|---|
| ME-500(C) Strength of Materials | 3-0 |
| Ma-102(C) Differential Equations and Series | 5-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| EE-271(C) AC Circuits | 3-2 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| | 16-6 |

### Third Term

| | |
|---|---|
| Ph-610(B) Atomic Physics | 3-0 |
| Ma-103(B) Functions of Several Variables and Vector Analysis | 5-0 |
| Mc-201(A) Methods in Dynamics | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| EE-272(C) AC Circuits | 2-2 |
| | 15-6 |

### Fourth Term

| | |
|---|---|
| Ma-104(A) Partial Differential Equations and Related Topics | 5-0 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| ME-111(C) Engineering Thermodynamics | 4-2 |
| EE-371(C) DC Machinery | 3-2 |
| | 15-6 |

Intersessional Field Trip; summer leave period.

## SECOND YEAR (NL2)

### First Term

| | |
|---|---|
| EE-471(C) Transformers, Asynchronous Machines and Synchros | 3-4 |
| ME-112(B) Engineering Thermodynamics | 4-2 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| EE-273(C) Electrical Measurements I | 2-3 |
| NE-101(C) Main Propulsion | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 14-12 |

### Second Term

| | |
|---|---|
| EE-472(C) Synchronous Machines | 3-4 |
| EE-651(B) Transients and Servos | 3-4 |
| EE-971(A) Seminar | 1-0 |
| ME-221(C) Marine Power Plant Equipment | 3-2 |
| ME-421(C) Hydromechanics | 3-2 |
| | 13-12 |

### Third Term

| | |
|---|---|
| EE-571(B) Transmission Lines and Filters | 3-4 |
| EE-771(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| ME-222(C) Marine Power Plant Equipment | 3-4 |
| NE-102(C) Auxiliary Machinery | 3-0 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 13-12 |

Fourth Term

| | |
|---|---|
| EE-772(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| ME-217(C) Internal Combustion Engines | 4-2 |
| EE-274(B) Electrical Measurements II | 2-3 |
| NE-103(C) Engineering Department Organization | 2-0 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 12-9 |

*Lecture course only; no academic credit.

This curriculum normally leads to the degree of Bachelor of Science in Electrical Engineering, for students who attain the required quality point rating.

### Advanced Curriculum (Three Years)

Designed for students, selected from the NL group at the end of the first year, whose performance and records qualify them for advanced study.

#### FIRST YEAR

Same as basic curriculum.

#### SECOND YEAR (NLA2)

First Term

| | |
|---|---|
| EE-471(C) Transformers, Asynchronous Machines and Synchros | 3-4 |
| EE-273(C) Electrical Measurements I | 2-3 |
| ME-112(B) Engineering Thermodynamics | 4-2 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 11-12 |

Second Term

| | |
|---|---|
| Ma-106(A) Complex Variables and Laplace Transform | 4-0 |
| EE-472(C) Synchronous Machines | 3-4 |
| EE-971(A) Seminar | 1-0 |
| ME-221(C) Marine Power Plant Equipment | 3-2 |
| ME-421(C) Hydromechanics | 3-2 |
| | 14-8 |

Third Term

| | |
|---|---|
| EE-571(B) Transmission Lines and Filters | 3-4 |
| EE-771(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| ME-222(C) Marine Power Plant Equipment | 3-4 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 10-12 |

Fourth Term

| | |
|---|---|
| EE-772(B) Electronics | 3-2 |
| EE-971(A) Seminar | 1-0 |
| EE-274(B) Electrical Measurements II | 2-3 |
| Ma-301(B) Statistics | 3-2 |
| ME-223(B) Marine Power Plant Analysis | 2-4 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 11-13 |

Intersessional Field Trip; summer leave period.

*Lecture course—no academic credit.

#### THIRD YEAR (NLA3)

(For classes graduating in 1954 and subsequent years.)

First Term

| | |
|---|---|
| Ma-105(A) Fourier Series and Boundary Value Problems | 4-0 |
| EE-671(A) Transients | 3-4 |
| EE-871(A) Electrical Machine Design | 4-0 |
| Ph-361(A) Electromagnetism | 3-0 |
| NE-101(C) Main Propulsion | 3-0 |
| | 17-4 |

Second Term

| | |
|---|---|
| EE-672(A) Servomechanisms | 3-3 |
| EE-872(A) Electrical Machine Design | 4-0 |
| EE-971(A) Seminar | 1-0 |
| Ph-362(A) Electromagnetic Waves | 3-0 |
| EE-972(A) Thesis | 2-6 |
| | 13-9 |

Third Term

| | | |
|---|---|---|
| EE-873(A) | Electrical Machine Design | 4-0 |
| EE-971(A) | Seminar | 1-0 |
| EE-972(A) | Thesis | 2-16 |
| NE-102(C) | Auxiliary Machinery | 3-0 |
| | | 10-16 |

Fourth Term

| | | |
|---|---|---|
| EE-874(A) | Electrical Machine Design | 4-0 |
| ME-217(C) | Internal Combustion Engines | 4-2 |
| EE-971(A) | Seminar | 1-0 |
| NE-103(C) | Engineering Department Administration | 2-0 |
| EE-972(A) | Thesis | 2-10 |
| | | 13-12 |

Note: For the current year only, the NL3 group graduating in 1953 will take the following third year's work in lieu of that set forth above:

First Term

| | | |
|---|---|---|
| EE-871(A) | Electrical Machine Design | 4-0 |
| EE-671(A) | Transients | 3-4 |
| EE-273(C) | Electrical Measurements I | 2-3 |
| ME-223(B) | Marine Power Plant Analysis | 2-4 |
| NE-101(C) | Main Propulsion | 3-0 |
| | | 14-11 |

Second Term

| | | |
|---|---|---|
| Mt-301(A) | High Temperature Materials | 3-0 |
| EE-872(A) | Electrical Machine Design | 4-0 |
| EE-971(A) | Seminar | 1-0 |
| EE-672(A) | Servomechanisms | 3-3 |
| EE-972(A) | Thesis | 3-0 |
| | | 14-3 |

Third Term

| | | |
|---|---|---|
| EE-873(A) | Electrical Machine Design | 4-0 |
| EE-971(A) | Seminar | 1-0 |
| NE-102(C) | Auxiliary Machinery | 3-0 |
| EE-972(A) | Thesis | 2-10 |
| | | 10-10 |

Fourth Term

| | | |
|---|---|---|
| EE-874(A) | Electrical Machine Design | 4-0 |
| EE-971(A) | Seminar | 1-0 |
| ME-217(C) | Internal Combustion Engines | 4-2 |
| NE-103(C) | Engineering Department Administration | 2-0 |
| EE-972(A) | Thesis | 2-8 |
| | | 13-10 |

This curriculum normally leads to the degree of Master of Science in Electrical Engineering, for those who attain the required quality point rating and complete a satisfactory thesis.

# GAS TURBINES CURRICULUM

## OBJECTIVE

The objective of this curriculum is, by means of practical and theoretical instruction, to qualify a selected group of officers for:

(a) Evaluating future trends in the field of gas turbine and jet propulsion and advising as to the limitations and capabilities of such means as applicable to propulsion requirements of naval vessels.

(b) Directing and supervising research and development in the field of gas turbine and jet propulsion as may be applicable to propulsion of naval vessels.

(c) Acting in an advisory capacity with civilian establishments in the development and production of such naval machinery as may in the future be operated by the use of gas turbines and jet propulsion.

The students for the gas turbines program are normally selected after the end of the first term, from the mechanical engineering (NH) group. Volunteers for this specialized program must have excellent previous academic records, and high grades for the first term. Mathematics and mechanics are particularly important as prerequisites.

## FIRST YEAR (NJ)

### First Year

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-101(C) Introduction to Engineering Mathematics | 3-0 |
| Ma-201(C) Graphical and Mechanical Computation | 0-2 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-8 |

### Second Term

| | |
|---|---|
| Ma-102(C) Differential Equations and Series | 5-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ae-100(C) Aerodynamics | 3-4 |
| EE-251(C) AC Circuits | 3-4 |
| | 14-8 |

### Third Term

| | |
|---|---|
| EE-451(C) Transformers and Synchros | 2-2 |
| Ma-103(B) Functions of Several Variables and Vector Analysis | 5-0 |
| Mc-201(A) Methods in Dynamics | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Ch-411(C) Physical Chemistry | 3-2 |
| | 15-8 |

### Fourth Term

| | |
|---|---|
| Ma-104(C) Partial Differential Equations and Related Topics | 5-0 |
| Ch-611(C) Thermodynamics | 3-2 |
| EE-452(C) Polyphase Transformers, Synchronous Machines, and Induction Motors | 3-4 |
| Ch-412(C) Physical Chemistry | 3-2 |
| | 14-8 |

Intersessional Field Trip; summer leave period.

## SECOND YEAR (NJ2)

### First Term

| | |
|---|---|
| Ma-105(A) Fourier Series and Boundary Value Problems | 4-0 |
| Ae-501(A) Hydro-Aero-Mechanics I | 4-0 |
| Ch-541(A) Reaction Motors | 2-2 |
| ME-511(C) Strength of Materials | 5-0 |
| Ch-612(C) Thermodynamics | 3-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 18-5 |

### Second Term

| | |
|---|---|
| Ma-106(A) Complex Variables and Laplace Transform | 4-0 |
| Ae-502(A) Hydro-Aero-Mechanics II | 4-0 |
| ME-611(C) Materials Testing Laboratory | 2-2 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| | 15-6 |

Third Term

| | |
|---|---|
| Ae-451(C) Gas Turbine Seminar | 3-0 |
| Ae-503(A) Compressibility I | 4-0 |
| Ch-701(C) Chemical Engineering Calculations | 3-2 |
| ME-622(B) Experimental Stress Analysis | 2-2 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 14-8 |

Fourth Term

| | |
|---|---|
| Mt-301(A) High Temperature Materials | 3-0 |
| Ae-452(C) Gas Turbine Seminar | 3-0 |
| Ae-431(A) Internal Flow in Aircraft Engines | 4-0 |
| ME-310(B) Heat Transmission | 3-2 |
| EE-751(C) Electronics | 3-4 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-8 |

*Lecture course—no academic credit.

Intersessional Field Trip; summer leave period.

## THIRD YEAR (NJ3)

At a civilian university. Subjects generally equivalent to the following are studied:

Flow of Compressible Fluids
Gas Turbines
Principles of Combustion
Fluid Machinery
Heat Transfer
Thesis

This curriculum normally leads to the degree of Master of Science, conferred by the university on students who attain the required grades and submit an acceptable thesis.

# MECHANICAL ENGINEERING CURRICULA

## OBJECTIVE

The objective of these curricula is to prepare officers in advanced mechanical engineering, for technical and administrative duties ashore and afloat, involving research, development, design, and inspection of naval machinery and engineering plants.

### Basic Curriculum (Two Years)

Designed to supply broad coverage in a variety of subjects which are essential to understanding of modern naval engineering.

## FIRST YEAR (NH)

### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-101(C) Introduction to Engineering Mathematics | 3-0 |
| Ma-201(C) Graphical and Mechanical Computation | 0-2 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-8 |

### Second Term

| | |
|---|---|
| Ma-102(C) Differential Equations and Series | 5-0 |
| Ph-610(B) Atomic Physics | 3-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| EE-251(C) AC Circuits | 3-4 |
| | 16-6 |

### Third Term

| | |
|---|---|
| Ma-103(B) Functions of Several Variables and Vector Analysis | 5-0 |
| Mc-201(A) Methods in Dynamics | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| EE-351(C) DC Machinery | 2-2 |
| EE-451(C) Transformers and Synchros | 2-2 |
| | 14-8 |

### Fourth Term

| | |
|---|---|
| Ma-104(A) Partial Differential Equations and Related Topics | 5-0 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| ME-111(C) Engineering Thermodynamics | 4-2 |
| EE-452(C) Polyphase Transformers, Synchronous Machines and Induction Motors | 3-4 |
| | 15-8 |

Intersessional Field Trip; summer leave period.

## SECOND YEAR (NH2)

### First Term

| | |
|---|---|
| ME-112(B) Engineering Thermodynamics | 4-2 |
| ME-511(C) Strength of Materials | 5-0 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| Mt-301(A) High Temperature Materials | 3-0 |
| NE-101(C) Main Propulsion | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 17-5 |

### Second Term

| | |
|---|---|
| ME-221(C) Marine Power Plant Equipment | 3-2 |
| ME-522(C) Strength of Materials | 4-0 |
| ME-611(C) Material Testing Laboratory | 2-2 |
| ME-421(C) Hydromechanics | 3-2 |
| ME-711(B) Mechanics of Machinery | 3-2 |
| | 15-8 |

Third Term

| | |
|---|---|
| ME-222(C) Marine Power Plant Equipment | 3-4 |
| ME-622(B) Experimental Stress Analysis | 2-2 |
| ME-422(C) Hydromechanics | 2-2 |
| ME-712(A) Dynamics of Machinery | 3-2 |
| NE-102(C) Auxiliary Machinery | 3-0 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 13-12 |

Fourth Term

| | |
|---|---|
| ME-217(C) Internal Combustion Engines | 4-2 |
| ME-223(B) Marine Power Plant Analysis | 2-4 |
| ME-820(C) Machine Design | 2-4 |
| EE-751(C) Electronics | 3-4 |
| NE-103(C) Engineering Department Administration | 2-0 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 13-16 |

*Lecture course—no academic credit.

This curriculum normally leads to the degree of Bachelor of Science in Mechanical Engineering, for students who attain the required quality point rating.

# ADVANCED MECHANICAL ENGINEERING CURRICULUM

Designed for students, chosen from the NH Group at end of first year, whose performance and records qualify them for advanced study. The second year, slightly different from that of the basic (NH) two-year curriculum, supplies, among other things, the prerequisites for the high level third-year courses.

## FIRST YEAR

Same as basic curriculum.

## SECOND YEAR (NHA2)

### First Term

| | |
|---|---|
| ME-112(B) Thermodynamics | 4-2 |
| ME-511(C) Strength of Materials | 5-0 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| Mt-301(A) High Temperature Materials | 3-0 |
| NE-101(C) Main Propulsion | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 17-5 |

### Second Term

| | |
|---|---|
| ME-611(C) Materials Testing Laboratory | 2-2 |
| ME-211(C) Marine Power Plant Equipment | 3-2 |
| ME-512(A) Strength of Materials | 5-0 |
| ME-411(C) Hydromechanics | 3-2 |
| ME-711(B) Mechanics of Machinery | 3-2 |
| | 16-8 |

### Third Term

| | |
|---|---|
| ME-212(C) Marine Power Plant Equipment | 3-4 |
| ME-412(A) Hydromechanics | 3-2 |
| ME-712(A) Dynamics of Machinery | 3-2 |
| NE-102(C) Auxiliary Machinery | 3-0 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 12-10 |

### Fourth Term

| | |
|---|---|
| ME-513(A) Theory of Elasticity | 3-0 |
| ME-310(B) Heat Transmission | 3-2 |
| Ae-431(A) Internal Flow in Aircraft Engines | 4-0 |
| Ph-450(B) Underwater Acoustics | 3-2 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 13-6 |

*Lecture course—no academic credit.

Intersessional Field Trip; summer leave period.

## THIRD YEAR (NHA3)

(For classes graduating in 1954 and subsequent years.)

### First Term

| | |
|---|---|
| ME-215(A) Marine Power Plant Analysis | 2-4 |
| ME-612(A) Experimental Stress Analysis | 3-2 |
| Ch-561(A) Physical Chemistry | 3-2 |
| Ph-240(C) Geometrical and Physical Optics | 3-3 |
| | 11-11 |

### Second Term

| | |
|---|---|
| ME-216(A) Marine Power Plant Design | 2-4 |
| ME-811(C) Machine Design | 3-2 |
| Ch-521(A) Plastics | 3-2 |
| EE-751(C) Electronics | 3-4 |
| | 11-12 |

### Third Term

| | |
|---|---|
| ME-812(B) Machine Design | 3-4 |
| EE-551(B) Transmission Lines and Filters | 3-2 |
| Thesis | 2-14 |
| | 8-20 |

### Fourth Term

| | |
|---|---|
| ME-217(C) Internal Combustion Engines | 4-2 |
| EE-651(B) Transients and Servos | 3-4 |
| NE-103(C) Engineering Department Administration | 2-0 |
| Thesis | 2-12 |
| | 11-18 |

Note: For the current year only, the NH3 group, graduating in 1953, will take the following third year's work in lieu of that set forth above:

First Term

| | |
|---|---|
| ME-215(A) Marine Power Plant Analysis | 2-4 |
| ME-310(B) Heat Transfer | 3-2 |
| ME-612(A) Experimental Stress Analysis | 3-2 |
| Mt-203(B) Physical Metallurgy | 2-2 |
| NE-101(C) Marine Engineering (Main Propulsion) | 3-0 |
| | 13-10 |

Second Term

| | |
|---|---|
| ME-216(A) Marine Power Plant Design | 2-4 |
| ME-811(C) Machine Design | 3-2 |
| EE-651(B) Transients and Servos | 3-4 |
| Mt-301(A) High Temperature Materials | 3-0 |
| | 11-10 |

Third Term

| | |
|---|---|
| NE-102(C) Auxiliary Machinery | 3-0 |
| ME-812(C) Machine Design | 3-4 |
| Thesis | 2-10 |
| | 8-14 |

Fourth Term (Tentative)

| | |
|---|---|
| NE-103(C) Engineering Department Administration | 2-0 |
| Thesis | 2-20 |
| | 4-20 |

(Other subjects may be added.)

This curriculum normally leads to the degree of Master of Science in Mechanical Engineering, for those who attain the required quality point rating and complete a satisfactory thesis.

# MECHANICAL ENGINEERING (EQUALIZATION) CURRICULUM

## OBJECTIVE

The objectives of this curriculum are:

(a) To supplement previous technical education of certain engineering duty officers.

(b) To further prepare these officers for engineering assignments under the cognizance of the Bureau of Ships, involving inspection, installation, operation, maintenance and repair of naval machinery and equipment, with the exception of radio and sound equipment.

## FIRST YEAR (NQ)

### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-140(C) Survey of Calculus | 3-0 |
| Ch-101(C) General Inorganic Chemistry | 3-2 |
| EE-151(C) DC Circuits and Fields | 3-4 |
| | 11-6 |

### Second Term

| | |
|---|---|
| Ma-171(C) Special Topics in Calculus I | 3-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-521(A) Plastics | 3-2 |
| EE-251(C) AC Circuits | 3-4 |
| | 12-6 |

### Third Term

| | |
|---|---|
| Ma-172(C) Special Topics in Calculus II | 3-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| ME-500(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| EE-351(C) DC Machinery | 2-2 |
| | 14-6 |

### Fourth Term

| | |
|---|---|
| Ma-173(B) Special Topics in Calculus III | 3-0 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| ME-111(C) Engineering Thermodynamics | 4-2 |
| ME-700(C) Kinematics of Machinery | 3-2 |
| EE-451(C) Transformers and Synchros | 2-2 |
| | 15-8 |

Intersessional Field Trip; summer leave period.

## SECOND YEAR (NQ2)

### First Term

| | |
|---|---|
| Ma-174(B) Special Topics in Calculus IV | 3-0 |
| Mt-301(A) High Temperature Materials | 3-0 |
| ME-122(C) Engineering Thermodynamics | 3-2 |
| EE-452(C) Polyphase Transformers, Synchronous Machines, and Induction Motors | 3-4 |
| NE-101(C) Main Propulsion | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 15-7 |

### Second Term

| | |
|---|---|
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| ME-221(C) Marine Power Plant Equipment | 3-2 |
| ME-421(C) Hydromechanics | 3-2 |
| EE-751(C) Electronics | 3-4 |
| | 11-10 |

### Third Term

| | |
|---|---|
| ME-222(C) Marine Power Plant Equipment | 3-4 |
| ME-422(B) Hydromechanics | 2-2 |
| Ph-610(B) Atomic Physics | 3-0 |
| NE-102(C) Auxiliary Machinery | 3-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 11-8 |

### Fourth Term

| | |
|---|---|
| ME-217(C) Internal Combustion Engines (Diesel) | 4-2 |
| ME-223(B) Marine Power Plant Analysis | 2-4 |
| ME-830(C) Machine Design | 4-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| | 10-10 |

*Lecture course—no academic credit.

This curriculum, when satisfactorily completed by students who have also completed technical or engineering programs at accredited civilian institutions, normally leads to the degree of Bachelor of Science. Each student must request that he be considered for the degree and submit, with his request a copy of his academic transcript from the civilian institution.

# METALLURGICAL ENGINEERING CURRICULUM

## OBJECTIVE

The objective of this curriculum is to prepare a small group of officers in advanced metallurgical engineering, for technical and administrative duties in connection with the following:

(a) Research involving metals and alloys.

(b) Development in metallurgy to meet the requirements of the Navy.

(c) Bureau of Ships activities involving uses of metals and alloys in naval equipment.

## FIRST YEAR (NM)

### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-111(C) Introduction to Engineering Mathematics | 3-0 |
| Ma-201(C) Graphical and Mechanical Computations | 0-2 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-8 |

### Second Term

| | |
|---|---|
| Ma-112(B) Differential Equations and Boundary Value Problems | 4-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ch-221(C) Qualitative Analysis | 3-2 |
| ME-500(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| EE-251(C) AC Circuits | 3-4 |
| | 16-8 |

### Third Year

| | |
|---|---|
| Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ch-231(C) Quantitative Analysis | 2-3 |
| Ch-411(C) Physical Chemistry | 3-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Ph-610(B) Atomic Physics | 3-0 |
| | 14-7 |

### Fourth Term

| | |
|---|---|
| Ma-114(A) Partial Differential Equations and Functions of a Complex Variable | 3-0 |
| Ch-611(C) Thermodynamics | 3-2 |
| Ch-412(C) Physical Chemistry | 3-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| Mt-203(B) Physical Metallurgy (Special Topics) | 2-2 |
| | 14-8 |

Intersessional Field Trip; summer leave period.

## SECOND YEAR (NM2)

### First Term

| | |
|---|---|
| Cr-271(B) Crystallography and X-ray Techniques | 3-2 |
| Ch-612(C) Thermodynamics | 3-2 |
| Mt-301(A) High Temperature Materials | 3-0 |
| EE-314(C) DC and AC Machinery | 3-4 |
| Mt-102(C) Production of Steel | 3-0 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 15-9 |

### Second Term

| | |
|---|---|
| Mt-204(A) Physical Metallurgy | 3-4 |
| Mt-205(A) Advanced Physical Metallurgy | 3-4 |
| ME-711(B) Mechanics of Machinery | 3-2 |
| ME-421(C) Hydromechanics | 3-2 |
| | 12-12 |

### Third Term

| | |
|---|---|
| Mt-103(C) Production of Non-Ferrous Metals | 3-0 |
| Mt-302(A) Alloy Steels | 4-2 |
| Ch-521(A) Plastics | 3-2 |
| ME-422(A) Hydromechanics | 2-2 |
| ME-622(B) Experimental Stress Analysis | 2-2 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 14-10 |

Fourth Term

| | |
|---|---|
| Ma-301(B) Statistics | 3-2 |
| Mt-303(A) Metallurgy Seminar | 2-0 |
| Mt-401(A) Physics of Metals | 3-0 |
| Mt-206(A) Advanced Physical Metallurgy | 3-4 |
| Ch-531(A) Physical Chemistry (for Metallurgical Students) | 2-0 |
| ME-310(B) Heat Transmission | 3-2 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-10 |

*Lecture course—no academic credit.

Intersessional Field Trip for students selected for a third year; summer leave period.

THIRD YEAR (NM3)

At a civilian university. Subjects generally similar to the following:

Alloy Steels
Advanced Physical Metallurgy
Graduate Seminar
Metallurgical Problems
Statistical Quality Control
Non-Ferrous Metallography
Mechanical Metallurgy
Crystallography
Theory of Solids
Thesis

Students attending the civilian university will receive a degree of Master of Science from the university provided they meet the requirements in subject matter, grades, and thesis.

# PETROLEUM ENGINEERING CURRICULUM

## OBJECTIVE

The objective of this curriculum is to prepare a small group of officers in the technology of petroleum production, refining, and utilization of by-products, for duties involving development, properties, and application of fuels and lubricants in the Naval Establishment.

## FIRST YEAR (NP)

### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-111(C) Introduction to Engineering Mathematics | 3-0 |
| Ma-201(C) Graphical and Mechanical Computation | 0-2 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Inorganic Chemistry | 3-2 |
| EE-171(C) Electric Circuits and Fields | 3-4 |
| | 14-8 |

### Second Term

| | |
|---|---|
| Ma-112(B) Differential Equations and Boundary Value Problems | 4-0 |
| Ch-221(C) Qualitative Analysis | 3-2 |
| Ge-101(C) Physical Geology | 3-0 |
| ME-500(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| Ge-241(C) Geology of Petroleum | 2-2 |
| | 15-6 |

### Third Term

| | |
|---|---|
| Ch-231(C) Quantitative Analysis | 2-3 |
| Ch-411(C) Physical Chemistry | 3-2 |
| Ch-311(C) Organic Chemistry | 3-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Cr-301(B) Crystallography and Mineralogy | 3-4 |
| | 14-13 |

### Fourth Term

| | |
|---|---|
| Ch-412(C) Physical Chemistry | 3-2 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| Ge-401(C) Petrology | 2-3 |
| Ge-302(C) Determinative Mineralogy | 1-4 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| | 11-13 |

Intersessional Field Trip; summer leave period.

---

Second and third years are at a civilian university. Subjects generally similar to the following are taken:

Introduction to Chemical Engineering
Physical Chemistry
Seminar in Petroleum Processing
Principles of Engineering Investment and Economy
Petroleum Production Economics
Petroleum Production Methods

Students attending the civilian university will receive a degree of Master of Science from the university provided they meet the requirements in subject matter and grades.

# ORDNANCE ENGINEERING CURRICULA

The objective of all Ordnance Engineering curricula is to prepare officers for shore duty assignments under the cognizance of the Bureau of Ordnance. This duty includes technical and technical administrative billets within the Bureau of Ordnance and in its field activities, which include the Naval Ordnance Test Stations, the Naval Proving Ground, the Naval Ordnance Laboratory, the Naval Ammunition Depots and Magazines, the Naval Gun Factory, the Naval Ordnance Plants and the Naval Powder Factory. While the curricula are definitely pointed toward shore duty assignments in ordnance activities, the knowledge acquired will be of exceedingly great value in gunnery billets afloat.

## GENERAL ORDNANCE—O GROUPS

### OBJECTIVE

The objective of the Ordnance Engineering (General) curricula is to give the student a basic technical education to prepare him for administration of research and development projects in Bureau of Ordnance establishments, and for future duties as inspectors of ordnance material. Officers selected for the third year at Massachusetts Institute of Technology will specialize in the theory and design of control devices.

### UNDER REVISION

Note: Printed below are the curricula which began in August 1950. These curricula will terminate with the group graduating in June 1954.

### FIRST YEAR (O)

#### First Term

| | |
|---|---|
| Ma-151(C) Introduction to Engineering Mathematics | 4-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-151(C) DC Circuits and Fields | 3-4 |
| Or-120(C) Surface Fire Control | 2-0 |
| | 15-6 |

#### Second Term

| | |
|---|---|
| Ma-152(B) Differential Equations and Boundary Value Problems | 4-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ch-711(C) Chemical Engineering Calculations | 3-2 |
| EE-241(C) AC Circuits | 3-2 |
| Ph-250(C) Optics | 3-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 16-7 |

#### Third Term

| | |
|---|---|
| Ma-153(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ph-610(C) Atomic Physics | 3-0 |
| Ch-631(A) Chemical Engineering Thermodynamics | 3-2 |
| EE-461(C) Transformers and Synchros | 3-2 |
| Ma-301(B) Statistics | 3-2 |
| Or-131(C) Anti-Aircraft Fire Control | 2-0 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 17-8 |

#### Fourth Term

| | |
|---|---|
| Ma-154(A) Partial Differential Equations and Functions of Complex Variables | 3-0 |
| EE-462(B) Asynchronous Motors and Special Machines | 4-2 |
| Ph-450(B) Underwater Acoustics | 3-2 |
| Ch-401(A) Physical Chemistry | 3-2 |
| Mc-421(A) Interior Ballistics | 2-0 |
| Or-132(C) Anti-Aircraft Fire Control | 2-0 |
| *IE-104(C) Psychophysical Systems (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 17-8 |

*Lecture course—no academic credit.

Intersessional Field Trip.

## SECOND YEAR (O2)

### First Term

| | |
|---|---|
| ME-541(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| Ch-541(A) Reaction Motors | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| EE-665(B) Lines, Filters, and Transients | 4-2 |
| Or-141(C) Guided Missiles | 2-0 |
| | 14-8 |

### Second Term

| | |
|---|---|
| ME-441(C) Hydromechanics | 4-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| EE-751(C) Electronics | 3-4 |
| ME-542(B) Strength of Materials | 3-0 |
| Or-142(C) Guided Missile Guidance | 2-0 |
| | 15-8 |

### Third Term

| | |
|---|---|
| ME-442(B) Compressible Fluid Flow | 2-2 |
| Mt-203(B) Physical Metallurgy | 2-2 |
| EE-745(A) Electronic Control and Measurements | 3-3 |
| Es-447(C) Electronic Pulse Techniques | 3-0 |
| Mc-401(A) Exterior Ballistics | 3-0 |
| Or-151(C) Underwater Ordnance | 2-0 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 15-9 |

### Fourth Term

| | |
|---|---|
| ME-740(C) Kinematics and Machine Design | 3-2 |
| Mt-301(A) High Temperature Materials | 3-0 |
| EE-672(A) Servomechanisms | 3-3 |
| Ch-520(B) Plastics | 2-2 |
| Mc-402(A) Dynamics of Missiles and Gyros | 3-0 |
| Or-152(C) Underwater Ordnance | 2-0 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-9 |

*Lecture course—no academic credit.

Intersessional Field Trip.

## THIRD YEAR (OF3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

### Fall Term

16.39T Vector Kinematics and Gyroscopic Instrument Theory
16.41 Fire Control Principles
16.43 Fire Control Instrument Laboratory
6.291 Principles of Radar
6.536 Machine Computation
Thesis

### Spring Term

16.42 Fire Control Systems
16.44T Advanced Fire Control Instruments Laboratory
6.292 Principles of Radar
Thesis

## AVIATION ORDNANCE—OE GROUPS

### OBJECTIVE

The objective of these curricula is to prepare naval aviation officers for duties in connection with research and development in the ordnance specialization above. Particular emphasis is placed on the theory and design of control devices.

### UNDER REVISION

Note: The curricula which began in 1950 for the OE Groups are identical to the curricula for the AR Groups given on pages 41 and 42 of this catalogue. These curricula for the OE Groups will terminate with those graduating in June 1954.

## JET PROPULSION ORDNANCE—OJ GROUPS

### OBJECTIVE

The objective of these curricula is to prepare officers for duty in connection with research and development in the ordnance specialization indicated above.

### UNDER REVISION

Note: Printed below are the curricula which began in August 1951. These curricula will terminate with the group graduating in June 1954.

### FIRST YEAR (OJ)

First Term

| | |
|---|---|
| Ma-151(C) Introduction to Engineering Mathematics | 4-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-151(C) DC Circuits and Fields | 3-4 |
| Or-120(C) Surface Fire Control | 2-0 |
| | 15-6 |

Second Term

| | |
|---|---|
| Ma-152(B) Differential Equations and Boundary Value Problems | 4-0 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| Ch-711(C) Chemical Engineering Calculations | 3-2 |
| EE-241(C) AC Circuits | 3-2 |
| Ae-100(C) Basic Aerodynamics | 3-4 |
| Ae-001(C) Aeronautical Lecture | 0-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 16-11 |

Third Term

| | |
|---|---|
| Ma-153(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ch-631(A) Chemical Engineering Thermodynamics | 3-2 |
| EE-461(C) Transformers and Synchros | 3-2 |
| Ma-301(B) Statistics | 3-2 |
| Ae-121(C) Technical Aerodynamics | 3-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 15-10 |

Fourth Term

| | |
|---|---|
| Ma-154(C) Partial Differential Equations and Functions of Complex Variables | 3-0 |
| Ch-401(A) Physical Chemistry | 3-2 |
| EE-462(B) Asychronous Motors Special Machines | 4-2 |
| Mc-421(A) Interior Ballistics | 2-0 |
| Ae-136(B) Aircraft Performance | 3-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| *IE-104(C) Psychophysical Systems (Lecture) | 0-1 |
| | 15-8 |

### SECOND YEAR (OJ2)

First Term

| | |
|---|---|
| ME-541(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| Ch-541(A) Reaction Motors | 2-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| Ae-501(A) Hydro-Aero-Mechanics I | 4-0 |
| Or-141(C) Guided Missiles | 2-0 |
| | 14-6 |

Second Term

| | |
|---|---|
| ME-542(B) Strength of Materials | 3-0 |
| EE-751(C) Electronics | 3-4 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| Ae-502(A) Hydro-Aero-Mechanics II | 4-0 |
| Or-142(C) Guided Missile Guidance | 2-0 |
| | 15-6 |

Third Term

| | |
|---|---|
| Mt-203(B) Physical Metallurgy | 2-2 |
| EE-745(A) Electronic Control and Measurements | 3-3 |
| Mc-401(A) Exterior Ballistics | 3-0 |
| Ae-503(A) Compressibility I | 4-0 |
| Or-151(C) Underwater Ordnance | 2-0 |
| Or-131(C) Anti-Aircraft Fire Control | 2-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 16-7 |

Fourth Term

| | |
|---|---|
| Mt-301(A) High Temperature Materials | 3-0 |
| EE-672(A) Servomechanisms | 3-3 |
| Mc-402(A) Dynamics of Missiles and Gyros | 3-0 |
| ME-740(C) Kinematics and Machine Design | 3-2 |
| Ch-301(C) Organic Chemistry | 3-2 |
| Or-152(C) Underwater Ordnance | 2-0 |
| *SL-102 New Weapons Developent II (Lecture) | 0-1 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| | 17-9 |

Intersessional Field Trip.

*Lecture course—no academic credit.

## THIRD YEAR (OJ3) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

First Term

Ae-261 Hydrodynamics
Ae-272 Precision Measurements
Ae-290 Aeronautical Seminar
JP-121 Rockets
JP-170 Jet Propulsion Laboratory
JP-200 Chemistry Problems in Jet Propulsion
JP-280 Research in Jet Propulsion

Second Term

Ae-261 Hydrodynamics
Ae-272 Precision Measurements
Ae-290 Aeronautical Seminar
JP-130 Thermal Jets
JP-170 Jet Propulsion Laboratory
JP-200 Chemistry Problems in Jet Propulsion
JP-280 Research in Jet Propulsion

Third Term

Ae-261 Hydrodynamics
Ae-272 Precision Measurements
Ae-290 Aeronautical Seminar
JP-130 Thermal Jets
JP-170 Jet Propulsion Laboratory
JP-210 High Temperature Design
JP-280 Research in Jet Propulsion

## CHEMICAL ORDNANCE—OP GROUPS

### OBJECTIVE

The objective of these curricula is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

### UNDER REVISION

Note: Printed below are the curricula which began in August 1951. These curricula will terminate with the group graduating in June 1954.

### FIRST YEAR (OP)

First Term

| | |
|---|---|
| Ma-151(C) Introduction to Engineering Mathematics | 4-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Ch-101(C) General Chemistry | 3-2 |
| EE-151(C) DC Circuits and Fields | 3-4 |
| Or-120(C) Surface Fire Control | 2-0 |
| | 15-6 |

Second Term

| | |
|---|---|
| Ma-152(B) Differential Equations and Boundary Value Problems | 4-0 |
| ME-500(C) Strength of Materials | 3-0 |
| ME-601(C) Materials Testing Laboratory | 0-2 |
| Ch-221(C) Qualitative Analysis | 3-2 |
| Ch-711(C) Chemical Engineering Calculations | 3-2 |
| EE-241(C) AC Circuits | 3-2 |
| *IE-101(C) Principles of Industrial Organization (Lecture) | 0-1 |
| | 16-9 |

Third Term

| | |
|---|---|
| Ma-153(B) Vector Analysis and Introduction to Partial Differential Equations | 3-0 |
| Ch-231(C) Quantitative Analysis | 2-4 |
| Ch-311(C) Organic Chemistry | 3-2 |
| Ch-411(C) Physical Chemistry | 3-2 |
| EE-461(C) Transformer and Synchros | 3-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 14-12 |

Fourth Term

| | |
|---|---|
| Ma-154(A) Partial Differential Equations and Functions of Complex Variables | 3-0 |
| Ch-611(C) Thermodynamics | 3-2 |
| Ch-312(C) Organic Chemistry | 3-2 |
| Ch-412(C) Physical Chemistry | 3-2 |
| EE-462(B) Asynchronous Motors and Special Machines | 4-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| *IE-104(C) Psychophysical Systems Research (Lecture) | 0-1 |
| | 16-10 |

*Lecture course—no academic credit.

## SECOND YEAR (OP2)

First Term

| | |
|---|---|
| Ch-541(A) Reaction Motors | 2-2 |
| Ch-612(C) Thermodynamics | 3-2 |
| Cr-271(B) Crystallography and X-ray Techniques | 3-2 |
| Mt-201(C) Introductory Physical Metallurgy | 3-2 |
| EE-665(B) Lines, Filters, and Transients | 4-2 |
| | 15-10 |

Second Term

| | |
|---|---|
| Ch-413(A) Advanced Physical Chemistry | 2-2 |
| Mt-202(C) Ferrous Physical Metallurgy | 3-2 |
| EE-751(C) Electronics | 3-4 |
| Ph-250(C) Optics | 3-2 |
| Ph-610(C) Atomic Physics | 3-0 |
| | 14-10 |

Third Term

| | |
|---|---|
| Ch-521(A) Plastics | 2-2 |
| EE-745(A) Electronic Control and Measurement | 3-3 |
| Ch-111(A) Fuel and Oil Chemistry | 2-2 |
| Ch-323(A) Chemistry of High Polymers | 3-0 |
| Ch-321(A) Organic Qualitative Analysis | 3-2 |
| Or-151(C) Underwater Ordnance | 2-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| *IE-103(C) Applied Industrial Organization (Lecture) | 0-1 |
| | 15-11 |

Fourth Term

| | |
|---|---|
| Ma-301(B) Statistics | 3-2 |
| EE-672(A) Servomechanisms | 3-3 |
| Ch-800(A) Chemistry Seminar | 2-0 |
| Ch-322(A) Advanced Organic Chemistry | 3-2 |
| Or-152(C) Underwater Ordnance | 2-0 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| | 13-9 |

Intersessional Field Trip.

*Lecture course—no academic credit.

## SPECIAL PHYSICS ORDNANCE—OX GROUPS

### OBJECTIVE

The objective of these curricula is to prepare officers for duties in connection with research and development in ordnance engineering.

## FIRST YEAR (OX)

First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Es-111(C) DC Electricity | 4-4 |
| Ma-181(C) Directional Derivatives and Locus Integrals | 3-0 |
| Mr-101(C) Fundamentals of Atmospheric Circulation | 3-0 |
| Ch-101(C) General Inorganic Chemistry | 3-2 |
| Or-141(C) Guided Missiles | 2-0 |
| | 17-6 |

Second Term

| | |
|---|---|
| Es-112(C) AC Electricity | 4-3 |
| Ma-182(C) Differential Equations and Vector Analysis | 5-0 |
| Ph-141(B) Analytical Mechanics | 4-0 |
| Or-142(C) Guided Missiles Guidance | 2-0 |
| Ph-250(C) Geometrical and Physical Optics | 3-2 |
| | 18-5 |

Third Term

| | |
|---|---|
| Ma-183(B) Complex Variables and the Differential Equations of Theoretical Physics | 5-0 |
| EE-451(C) Transformers and Synchros | 2-2 |
| Es-113(C) Circuit Analysis and Measurements | 3-3 |
| Es-261(C) Electron Tubes and Circuits | 3-2 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| Ph-142(B) Analytical Mechanics | 4-0 |
| | 17-8 |

Fourth Term

| | |
|---|---|
| Ma-194(A) Laplace Transforms, Matrices and Variations | 5-0 |
| EE-651(B) Transients and Servos | 3-4 |
| Es-114(C) Circuit Analysis and Measurements | 3-3 |
| Es-262(C) Electron Tubes and Circuits | 3-2 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 14-10 |

*Lecture course—no academic credit.

## SECOND YEAR (OX2) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Summer Term

6.80 Electrical Measurements Laboratory
8.08 Electronics

Fall Term

6.623 Pulse Circuits, Principles
8.05 Atomic Physics
8.07 Thermodynamics and Statistical Mechanics
8.71 Introduction to Theoretical Physics I (Mechanics)
L17 Scientific German

Spring Term

6.20 Electronic Control and Measurement
6.633 Electronic Circuit Theory
8.101 Atomic Structure Laboratory
or
8.102 Electronic Devices Laboratory
8.06 Nuclear Physics
8.72 Introduction to Theoretical Physics II (Electromagnetic Theory)

## THIRD YEAR (OX3) AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Fall Term

8.361 Quantum Theory of Matter
8.511 Nuclear Physics I
8.57 Neutron Physics
8.60 Special Problems in Nuclear Physics

Spring Term

8.512 Nuclear Physics II
8.52 Applied Nuclear Physics, Advanced
Thesis

# OPERATIONS ENGINEERING CURRICULUM

## OBJECTIVE

The objective of this curriculum is to further educate selected officers in general engineering and science, in basic principles of operations research, and in the application of those principles to naval problems. Operations research may be defined as "a scientific method of providing commanders with a quantitative basis for decisions regarding operations under their control."

Field work in this course will consist of active participation in the solving of current problems under the direction of the Chief of Naval Operations.

## OPERATIONS ANALYSIS—RO GROUPS

### FIRST YEAR (RO)

#### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-181(C) Directional Derivatives and Locus Integrals | 3-0 |
| Ma-251(C) Graphical and Mechanical Computation | 0-4 |
| Ph-240(C) Geometrical and Physical Optics | 3-3 |
| Ch-101(C) General Chemistry | 3-2 |
| Or-120(C) Surface Fire Control | 2-0 |
| | 13-9 |

#### Second Term

| | |
|---|---|
| Ma-182(C) Differential Equations and Vector Analysis | 5-0 |
| Ma-381(B) Probability | 4-0 |
| Ph-141(B) Analytical Mechanics | 4-0 |
| Ph-341(C) Electricity and Magnetism | 4-2 |
| | 17-2 |

#### Third Term

| | |
|---|---|
| Ma-183(B) Complex Variables and the Differential Equations of Theoretical Physics | 5-0 |
| Ph-142(B) Analytical Mechanics | 4-0 |
| Ph-361(A) Electromagnetism | 3-0 |
| Ma-382(A) Probability and Statistics | 2-0 |
| Oa-100(C) Introductory Problems in Operations Analysis | 2-0 |
| Or-131(C) Anti-Aircraft Fire Control | 2-0 |
| *SL-101 New Weapons Development I (Lecture) | 0-1 |
| | 18-1 |

#### Fourth Term

| | |
|---|---|
| Ma-184(A) Laplace Transforms and Matrices | 3-0 |
| Ph-362(A) Electromagnetic Waves | 3-0 |
| Ph-640(B) Atomic Physics | 3-3 |
| Oa-101(B) Theoretical Methods in Operations Analysis | 5-0 |
| Or-132(C) Anti-Aircraft Fire Control | 2-0 |
| *IE-104(C) Human Engineering (Lecture) | 0-1 |
| *SL-102 New Weapons Development II (Lecture) | 0-1 |
| | 16-5 |

Intersessional period—six weeks practical work.

*Lecture course—no academic credit.

### SECOND YEAR (RO2)

#### First Term

| | |
|---|---|
| Ph-421(A) Fundamental Acoustics | 3-0 |
| Ph-530(B) Thermodynamics | 3-0 |
| Ma-501(A) Theory of Games | 4-0 |
| Ma-383(A) Statistics | 2-3 |
| Oa-102(A) Weapon Systems and Combined Operations | 4-0 |
| Or-151(C) Underwater Ordnance | 2-0 |
| | 18-3 |

#### Second Term

| | |
|---|---|
| Ph-425(A) Underwater Acoustics | 3-2 |
| Es-446(C) Introduction to Radar | 2-2 |
| Ph-540(B) Kinetic Theory and Statistical Mechanics | 3-0 |
| Oa-103(A) Selected Topics in Operations Analysis | 5-3 |
| Or-152(C) Underwater Ordnance | 2-0 |
| | 15-7 |

Six months of practical work as directed by the Chief of Naval Operations.

# NUCLEAR ENGINEERING (EFFECTS) CURRICULA

## OBJECTIVE

The objective of these curricula is to qualify officers of the armed services in the fundamental sciences, especially in those pertaining to nuclear physics and in those associated with the problems that arise from the effects of atomic energy.

## NUCLEAR ENGINEERING (EFFECTS)—R2 GROUPS

### FIRST YEAR (RZ)

#### First Term

| | |
|---|---|
| Ma-100(C) Vector Algebra and Geometry | 2-0 |
| Ma-181(C) Directional Derivatives and Locus Integrals | 3-0 |
| Mc-101(C) Engineering Mechanics I | 3-0 |
| Mr-101(C) Fundamentals of Atmospheric Circulation | 3-0 |
| Ph-250(C) Geometrical and Physical Optics | 3-2 |
| | 14-2 |

#### Second Term

| | |
|---|---|
| Ma-182(B) Differential Equations and Vector Analysis | 5-0 |
| Ch-102(C) General Inorganic Chemistry | 4-2 |
| Es-271(C) Electronics I | 3-3 |
| Mc-102(C) Engineering Mechanics II | 3-0 |
| | 15-5 |

#### Third Term

| | |
|---|---|
| Ma-183(B) Complex Variables and the Differential Equations of Theoretical Physics | 5-0 |
| Ch-213(C) Quantitative Analysis | 2-3 |
| Es-272(C) Electronics II | 3-2 |
| Ge-101(C) Physical Geology | 3-0 |
| Ph-143(A) Analytical Mechanics | 3-0 |
| | 16-5 |

#### Fourth Term

| | |
|---|---|
| Ma-184(A) Laplace Transforms and Matrices | 3-0 |
| Ch-315(C) Organic Chemistry | 3-0 |
| Mc-311(A) Vibrations | 3-2 |
| Ph-351(B) Electricity and Magnetism | 5-0 |
| Ph-441(A) Longitudinal Waves in Fluids | 4-0 |
| | 18-2 |

### SECOND YEAR (RZ2)

#### First Term

| | |
|---|---|
| Ma-301(B) Statistics | 3-2 |
| Ch-442(C) Physical Chemistry | 4-2 |
| ME-150(C) Thermodynamics | 4-2 |
| Ph-641(B) Atomic Physics | 3-3 |
| | 14-9 |

#### Second Term

| | |
|---|---|
| *Bi Biology I | 4-3 |
| Ch-551(A) Radiochemistry | 2-2 |
| ME-350(C) Heat Transfer | 2-2 |
| Ph-541(B) Kinetic Theory and Statistical Mechanics | 4-0 |
| Ph-740(A) Introductory Quantum Mechanics | 3-0 |
| | 15-7 |

#### Third Term

| | |
|---|---|
| *Bi Biology II | 4-2 |
| Ch-591(A) Blast and Shock Effects | 3-0 |
| ME-550(B) Elastic Body Mechanics | 5-0 |
| Ph-642(A) Nuclear Physics | 3-0 |
| Thesis | 0-5 |
| | 15-7 |

#### Fourth Term

| | |
|---|---|
| *Bi Biology III | 4-3 |
| Thesis | 0-25 |
| | 4-28 |

*Biology courses to be taught at Monterey by the University of California Extension Division.

Note: Printed below are the curricula which began in 1948. These curricula will terminate with the group graduating in June 1954.

## SECOND YEAR (RZ2)

### First Term

| | | |
|---|---|---|
| Ma-180(C) | Vector Algebra and Geometry | 2-0 |
| Ma-181(C) | Directional Derivatives and Line Integrals | 4-0 |
| Ph-240(C) | Geometrical and Physical Optics | 3-3 |
| Ch-102(C) | General Inorganic Chemistry | 4-2 |
| Mr-101(C) | Atmospheric Circulation | 3-0 |
| | | 16-5 |

### Second Term

| | | |
|---|---|---|
| Ma-182(B) | Differential Equations and Vector Analysis | 5-0 |
| Ph-141(B) | Analytical Mechanics | 4-0 |
| Ph-341(C) | Electricity and Magnetism | 4-2 |
| Ch-213(C) | Quantitative Analysis | 3-4 |
| | | 16-6 |

### Third Term

| | | |
|---|---|---|
| Ma-183(B) | Complex Variables and the Differential Equations of Theoretical Physics | 5-0 |
| Ph-342(B) | Electricity and Magnetism | 3-3 |
| Ph-142(B) | Analytical Mechanics | 4-0 |
| Ch-315(C) | Organic Chemistry | 3-4 |
| | | 15-7 |

### Fourth Term

| | | |
|---|---|---|
| Ma-184(A) | Matrices, Tensors, and Variations | 5-0 |
| Ph-343(B) | Electricity and Magnetism | 3-0 |
| Ph-640(B) | Atomic Physics | 3-3 |
| Ch-442(C) | Physical Chemistry | 4-2 |
| Ph-540(B) | Kinetic Theory of Gases | 3-0 |
| | | 18-5 |

## SECOND YEAR (RZ2) AT UNIVERSITY OF CALIFORNIA

### SUMMER TERM

#### First Session

Zoology IA General Zoology
Physiology IA General Physiology

#### Second Session

Physiology 113 Advanced Physiology

#### Fall Semester

Ph 121 Introduction to Atomic Structure
Ph 128 and 128L Radiation Measurements
Chem 123 Nuclear Chemistry
Phys 100A General and Comparative Physiology
Pharmacology 142 Pharmacology

#### Spring Semester

Ph 124 Radioactivity and Nuclear Structure
Biochem 103 Animal Biochemistry
Biochem 206 Physiology Biochemistry
Ph 126 and 126L Biological Applications of Artificial Radioactivity
Bact 7 General Bacteriology
Intersessional Field Trip.

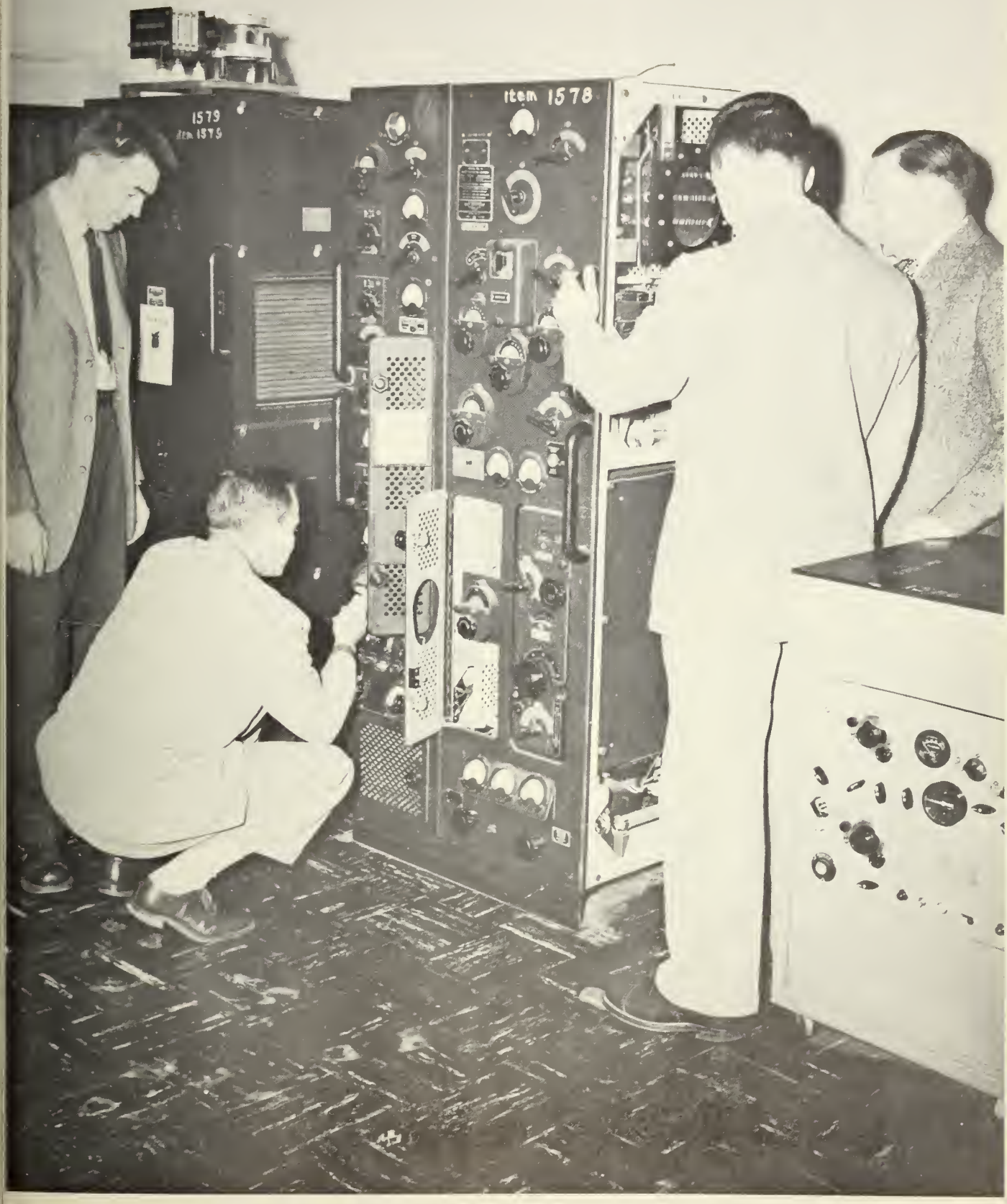
## THIRD YEAR (RZ3) AT UNIVERSITY OF CALIFORNIA

#### Fall Semester

Ph 231A Advanced Quantum Mechanics and Nuclear Physics
Ph 290 Seminar
Publ Hlth 288 Public Health, Disaster Control
Chem. Rad. or extension of Ph 290

#### Spring Semester

Ph 231B Advanced Quantum Mechanics and Nuclear Physics
Ph 290 Seminar
Phys 100D General Physiology
Final Comprehensive Examination.




A portion of the Engineering Electronics Laboratory showing students receiving instruction on radio transmitters.

Electrical Engineering Laboratory showing instruments used in a research on conductivity of oil in motion.

# PART III

## COURSE DESCRIPTIONS—ENGINEERING SCHOOL

Descriptive name of course is followed by two numbers, separated by a hyphen. The first number is classroom hours; the second, laboratory hours.

THE ACADEMIC LEVEL OF A COURSE IS INDICATED BY A LETTER IN PARENTHESES AFTER THE COURSE NUMBER AS FOLLOWS:

(A) Full graduate course
(B) Partial graduate course
(C) Undergraduate course

One term credit-hour is given for each hour of lecture or recitation, and half of this amount for each hour of laboratory work. A term credit-hour is equivalent to two thirds of the conventional semester credit-hour.

# AEROLOGY

Mr Courses



**Mr-101(C) Fundamentals of Atmospheric Circulation** 3-0

This course serves as an introductory course in meteorology, especially as it concerns large- and small-scale circulations, and the variations of these with height. It is designed primarily to give non-aerological student officers a minimum meteorological background.

Text: Petterssen: Introduction of Meteorology.

Prerequisite: None.

**Mr-110(C) Radiological Defense** 2-0

This course is devoted to a discussion of the basic hazards of the atomic bomb and the effects on personnel and materiel, including decontamination methods and personnel protective measures. The principle of operation of various field instruments for measuring radiation intensity and dosage is explained and their use is demonstrated. Some weather aspects of the atomic bomb are considered, with emphasis placed on the aerological problem of fall-out.

Text: Nucleonics for the Navy; USF 85.

Prerequisite: Ph-191(C) for MA Group, Mr-323(A) for MS group.

**Mr-200(C) Introduction to Synoptic Meteorology** 3-0

This course serves as a preparation for advanced study of synoptic meteorology. It is primarily an introduction to synoptic meteorology as a survey course, considering in turn the composition of the atmosphere, general circulation, air masses and air-mass changes, fronts, cyclones and anticyclones, weather analysis, and weather forecasting.

Text: Petterssen: Introduction to Synoptic Meteorology.

Prerequisite: None.

**Mr-201(C) Weather Maps and Codes** 2-9

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing; the reduction of the observed facts into short coded messages; and the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology. Finally, the students analyze an idealized series of weather maps.

Text: Hydrographic Office Publication H. O. 206; U. S. Weather Bureau Circulars "S" and "N", Radiosonde Code, International Code; Aerographer's Manual.

Prerequisite: None.

**Mr-202(C) Surface Weather Map Analysis** 2-9

The principles of surface weather map analysis are demonstrated by having the students analyze current daily weather charts, correlate upper wind data with the surface charts, observe the local surface weather elements, and discuss the map analysis.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Lockhart: Practical Aids in Weather Map Analysis; Petterssen: Weather Analysis and Forecasting.

Prerequisite: Mr-200(C), Mr-201(C).

**Mr-203(C) Weather Analysis and Forecasting** 2-12

This course is a continuation of Mr-202(C). More advanced methods of current weather map analysis and forecasting are presented. Students are taught the usefulness of upper air observations as related to the overall structure of the atmosphere. Daily forecasts and map discussions are included.

Text: Berry, Bollay, Beers: Handbook of Meteorology; NavAer 50-1R-177: Constant Pressure Analysis; Haltiner and Eaton: Constant Pressure and Differential Analysis; NavAer 50-1R-204: A Collection and Evaluation of Weather Forecasting Rules; Petterssen: Weather Analysis and Forecasting.

Prerequisite: Mr-202(C), Ma-162(C).

**Mr-204(C) Upper Air Analysis and Forecasting** 2-12

This course is a continuation of Mr-203(C), with emphasis on the relationship between various upper air charts and the sea level chart, including differential analyses. Various methods of prognosticating upper air charts are used. Daily forecasts and map discussions are continued.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Petterssen: Weather Analysis and Forecasting; Haltiner and Eaton: Constant Pressure and Differential Analysis; NavAer 50-1R-204: A Collection and Evaluation of Weather Forecasting Rules.

Prerequisite: Mr-203(C), Mr-301(C), Mr-402(C), Ma-163(C).

**Mr-215(B) Advanced Weather Analysis and Forecasting** 0-12

This course correlates the various analysis and forecasting techniques developed in previous synoptic and theoretical courses by means of laboratory solution of selected forecast problems.

Text: None.

Prerequisite: Mr-204(C), Mr-302(C), Mr-602(C).

**Mr-216(B) Advanced Weather Analysis and Forecasting** 0-12

This course is a continuation of course Mr-215(B). The student officers are taught to analyze and forecast the weather in accordance with the most advanced applied methods, using all available sources of information, including the surface maps, upper-level charts, winds-aloft data, and meteorograph and radiosonde observations. The course is coordinated with course Mr-217(B), where, in the upper level, charts are drawn and differential analyses, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None.

Prerequisite: Mr-215(B), Mr-303(C), Mr-403(C).

**Mr-217(B) Upper Air Analysis and Forecasting** 0-8

The course is devoted entirely to upper-air analysis, supplemented by surface map analysis in Mr-216(B), including constant-pressure analysis, cross-sections, etc.

Text: None.

Prerequisite: Mr-303(C), Mr-215(B), Mr-403(C).

**Mr-220(B) Selected Topics in Meteorology** 4-0

This course consists of lectures and concurrent reading assignments dealing with the synoptic aspects of Southern Hemisphere, tropical, and polar meteorology; the general circulation of the atmosphere; extended range forecasting; single station analysis and forecasting; and recent developments as time permits.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Haurwitz and Austin: Climatology; Selected NavAer, Weather Bureau, and miscellaneous publications.

Prerequisites: Mr-411(B), Mr-412(A).

**Mr-226(B) Advanced Weather Analysis and Forecasting** 2-9

Basic principles of weather map analysis are reviewed and more advanced methods of map analysis

and forecasting are presented. Students are taught the use of upper air observations in determining air-mass characteristics, movement of pressure systems, etc. The concept of three-dimensional weather analysis is stressed by the use of upper level charts, differential analyses, and vertical cross-sections. Group discussion of the map analysis and practice forecasts is included.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Petterssen: Weather Analysis and Forecasting; NavAer 50-1R-177: Constant Pressure Analysis; Haltiner and Eaton: Constant Pressure and Differential Analysis.

Prerequisite: Mr-411(B), Mr-412(A), Ma-103(B).

**Mr-227(B) Upper Air Analysis and Forecasting** 2-9

This course continues the instruction begun in course Mr-226(B). The students analyze upper air (constant pressure) charts, make differential analyses, and prepare prognostic surface and upper air charts, using the most recent three dimensional techniques. Discussions of the analyses and practice forecasts are continued.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Petterssen: Weather Analysis and Forecasting; Riehl and others: Middle Latitude Forecasting; NavAer 50-1R-204: A Collection and Evaluation of Weather Forecasting Rules.

Prerequisite: Mr-226(B), Mr-321(A), Mr-220(B).

**Mr-230(A) Operational Forecasting** 0-10

This course is a continuation of previous laboratory courses in weather analysis and forecasting. Using all available techniques, students analyze upper air and sea-level weather charts, prepare stability analyses and atmospheric cross sections, and construct prognostic charts. The information thus analyzed is correlated to prepare operational weather forecasts for various situations, including flight forecasts, ocean area forecasts, local station forecasts, and forecasts for selected types of naval operations.

Text: None.

Prerequisite: Mr-227(B), Mr-422(A).

**Mr-301(C) Synoptic Meteorology I** 4-0

This course deals with the fundamental theoretical concepts of synoptic meteorology, covering air-mass characteristics, precipitation processes, the general circulation, wind and pressure systems, the thermal wind, differential analysis, and frontogenesis.

Text: Petterssen: Weather Analysis and Forecasting; Berry, Bolley, Beers: Handbook of Meteorology.

Prerequisite: Mr-200(C), Ph-191(C), Ma-162(C).

**Mr-302(C) Synoptic Meteorology II** 4-0

This course is a continuation of Mr-301(C) and considers the following topics: frontal characteristics, the mechanism of pressure changes, Southern Hemisphere synoptic meteorology, and tropical analysis and forecasting.

Text: Petterssen: Weather Analysis and Forecasting; Berry, Bollay, Beers: Handbook of Meteorology.

Prerequisite: Mr-301(C), Mr-402(C).

**Mr-303(C) Synoptic Meteorology III** 4-0

This course is a continuation of Mr-302(C) and considers the following topics: arctic and antarctic synoptic meteorology, marine meteorology, the general circulation of the atmosphere, long-range forecasting, single-station analysis and forecasting, and recent developments in meteorological practice as time permits.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Starr: Basic Principles of Weather Forecasting.

Prerequisite: Mr-302(C).

**Mr-321(A) Dynamic Meteorology I** 3-0

This course consists of lectures and concurrent reading assignments on the following topics: scalar and vector fields; the equations of motion in scalar and vector forms and their solutions in special cases; streamlines and trajectories; the thermal wind equation in various forms; surfaces of discontinuity; solenoids and the circulation theorems.

Text: Holmboe, Forsythe, Gustin: Dynamic Meteorology; Petterssen: Weather Analysis and Forecasting.

Prerequisite: Mr-411(B), Mr-412(A), Ma-103(B).

**Mr-322(A) Dynamic Meteorology II** 3-0

This course is a continuation of Mr-321(A) covering the following topics: the continuity and tendency equations; convergence and divergence in general, and in application to wave-shaped systems; the vorticity theorem and applications; frontogenesis and frontolysis; perturbation techniques in the solution of the equations of motion; the general circulation, including applications of the foregoing theory.

Text: Holmboe, Forsythe, Gustin: Dynamic Meteorology; Petterssen: Weather Analysis and Forecasting.

Prerequisite: Mr-321(A), Ma-134(B).

**Mr-323(A) Dynamic Meteorology III (Turbulence and Diffusion)** 3-0

This course is a continuation of Mr-322(A) and considers the following topics: general effects of viscosity, equations of motion for laminar and turbulent flow, wind variation in the surface layer, energy changes in wind systems, transfer of properties by turbulent mass exchange, diurnal temperature variation, and transformation of air masses.

Text: Berry, Bollay, Beers: Handbook of Meteorology; Sutton: Atmospheric Turbulence; Brunt: Physical and Dynamical Meteorology.

Prerequisite: Mr-321(A), Ma-134(B).

**Mr-402(C) Meteorological Charts and Diagrams** 3-0

This course proceeds from a treatment of elementary thermodynamics to its application in meteorology, with particular emphasis on thermodynamic charts and diagrams. Atmospheric stability, instability phenomena, and the forecasting techniques are discussed.

Text: Haltiner: Mimeographed notes titled Elementary Meteorological Thermodynamics; U. S. Department of Commerce Publication: The Thunderstorm.

Prerequisite: Ph-191(C), Ma-162(C).

**Mr-403(C) Introduction to Physical Meteorology** 4-0

This course is a qualitative treatment of (1) radiation, solar and terrestrial, and its effect on atmospheric processes; (2) elementary theory of turbulence and diffusion and the effects of these processes on wind structure and air-mass modification.

Text: Haurwitz: Dynamic Meteorology; Berry, Bollay, Beers: Handbook of Meteorology.

Prerequisite: Mr-302(C), Ma-163(C).

**Mr-410(C) Meteorological Instruments** 2-2

Standard naval meteorological instruments are studied and used by the students. Additional instrumentation peculiar to (1) cold climates, (2) very high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and to reliability of observation.

Text: Middleton: Meteorological Instruments; Aerographer's Manual; U. S. Weather Bureau: Circular "P"; From: Instrument Work Book.

Prerequisite: Ph-191(C).

**Mr-411(B) Thermodynamics of Meteorology** 5-2

This course considers the following topics: the physical variables; the equation of state; first law of thermodynamics, properties of gases; properties of water and moist air; thermodynamic diagrams; air mass identification indices; geopotential determinations; instability phenomena and criteria.

Text: Holmboe, Forsythe, Gustin: Dynamic Meteorology; U. S. Department of Commerce Publication: The Thunderstorm.

Prerequisite: Ma-132(C), Ph-196(C).

**Mr-412(A) Physical Meteorology** 3-0

This course deals with (1) solar and terrestrial radiation, and (2) the physics of atmospheric phenomena in which optical or scattering effects are produced by clouds, fogs, raindrops, haze, etc.

Text: Elsasser: Heat Transfer by Infrared Radiation in the Atmosphere; Albright: Physical Meteorology.

Prerequisite: Ph-196(C), Ma-132(C).

**Mr-422(A) The Upper Atmosphere** 5-0

A study is made of the distribution of certain of the meteorological elements, including the composition of the upper atmosphere. A survey is made of the various layers of the upper atmosphere, together with the physical processes taking place in these layers. Wherever possible, the interplay of these processes with the meteorology of the troposphere is considered.

Text: Mitra: The Upper Atmosphere; Semat: Atomic Physics.

Prerequisite: Mr-322(A), Mr-323(A).

**Mr-510(C) Climatology** 2-0

This course considers the major continental and oceanic regions of the world with respect to their dominant weather characteristics and covers the meteorological and oceanographic processes that are important in the development of these characteristics.

Text: Haurwitz and Austin: Climatology.

Prerequisite: Mr-203(C), Mr-301(C).

**Mr-520(B) Applied Climatology** 2-0

Methods of classifying climates are reviewed, and the applications of statistical treatment of meteorological data and objective forecasting techniques to operational planning are shown.

Text: Jacobs: Wartime Developments in Applied Climatology.

Prerequisite: Ma-331(A), Mr-510(C) or equivalent.

**Mr-601(C) Introduction to Oceanography** 2-1

A survey is made of the physical, chemical, and biological properties of sea water. Ocean currents, water masses, and submarine geology are introduced. Instruments and techniques peculiar to oceanography are discussed and demonstrated.

Text: Sverdrup: Oceanography for Meteorologists; NDRC Summary Tech. Rep. Div. 6, Vol. 6A: The Application of Oceanography to Subsurface Warfare; Berry, Bollay, Beers: Handbook of Meteorology.

Prerequisite: Ma-161(C), Ph-190(C).

**Mr-602(C) Physical Oceanography** 2-0

In this course, the processes which operate to modify or to maintain the distribution of properties in the oceans are considered. Turbulence, diffusion, evaporation, and transfer of wind stresses are studied in their relation to the changes in the thermal and saline structures of the oceans.

Text: Sverdrup: Oceanography for Meteorologists; Berry, Bollay, Beers: Handbook of Meteorology; NDRC Summary Tech. Rep. Div. 6, Vol. 6A: The Application of Oceanography to Subsurface Warfare.

Prerequisite: Ph-191(C), Ma-163(C), Mr-601(C).

**Mr-603(C) Naval Applications of Oceanography** 4-2

The basic concepts of oceanography are applied to a variety of practical problems. These include the forecasting of underwater sound ranges, the prediction of the drift of life rafts, as well as problems of the near-shore region such as the flushing of estuaries and the formation of currents in the littoral zone.

Text: NDRC Summary Tech. Rep. Div. 6, Vol. 7: Principles of Underwater Sound; NDRC Summary Tech. Rep. Div. 6, Vol. 6A: The Applications of Oceanography to Subsurface Warfare; H. O. No. 235: Methods for Locating Survivors Adrift at Sea on Rubber Life Rafts; mimeographed notes.

Prerequisite: Mr-602(C), Mr-610(B).

**Mr-610(B) Wave, Swell and Surf Forecasting** 2-2

The following topics are considered: the characteristics of surface water waves; generation of waves; methods of forecasting sea and swell; methods of forecasting breakers and surf conditions.

Text: H.O. 604: Techniques for Forecasting Wind, Waves and Swell; H.O. 234: Breakers and Surf.

Prerequisite: Mr-302(C), Mr-602(C), for MA Group; Mr-322(A), Mr-611(B) for MS Group.

**Mr-611(B) General Oceanography** 3-1

This course describes the physical geography of the oceans and the ocean floor and the distribution of chemical and biological properties in the oceans. The general equations of motion are considered and applied, with appropriate simplifications, to corresponding types of oceanographic flow. Surface exchange of heat, moisture, and momentum are studied, and the standard oceanographic instruments are demonstrated.

Text: Sverdrup, Johnson, Fleming: The Oceans; NDRC Summary Tech. Rep. Div. 6, Vol. 6A: The Application of Oceanography to Subsurface Warfare; Holmboe, Forsythe, Gustin: Dynamic Meteorology.

Prerequisite: Ma-163(C) or equivalent, Mr-216(B) or equivalent.

**Mr-613(C) Applied Oceanography (Underwater Sound)** 2-1

The physics of underwater sound is presented and applied to sound transmission. Environmental factors such as thermal gradients, internal waves, bottom sediments, suspended materials, and ambient noise are considered. Echo ranging conditions are forecast from observed temperature gradients and the time changes of such gradients are discussed.

Text: NDRC Summary Tech. Rep. Div. 6, Vol. 7: Principles of Underwater Sound; NDRC Summary Tech. Rep. Div. 6, Vol. 6A: The Application of Oceanography to Subsurface Warfare; Berry, Bollay, Beers: Handbook of Meteorology.

Prerequisite: Mr-611(B), Ph-196(C) or equivalent.

**Mr-614(C) Military Oceanography** 2-2

Beach geology is discussed in connection with problems of amphibious warfare; tidal estuaries,

with emphasis on the flushing of contaminants by tidal action; drift of life rafts in connection with the air-sea rescue problem.

**Text:** Mimeographed notes.

**Prerequisite:** Mr-611(B), Mr-323(A).

**Mr-810(A) Seminar** 2-0

Students study and prepare synopses of current publications or original data concerning meteorology and present them for group discussion.

**Text:** None.

**Prerequisite:** Mr-220(B), Mr-422(A), Mr-520(B).

**Mr-921(A) Thesis I** 2-6

Students are expected to begin research on problems selected by themselves or assigned to them. Each student will be directed and assisted in his work by a staff member qualified in the special field of the problem selected.

**Text:** None.

**Prerequisite:** Mr-220(B), Mr-323(A), Ma-331(A).

**Mr-922(A) Thesis II** 4-0

This course is a continuation of Mr-921(A). The work begun in Mr-921(A) will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

**Text:** None.

**Prerequisite:** Mr-921(A), Mr-422(A).

# AERONAUTICS

Ae Courses



**Ae-001(C) Aeronautical Lecture Series** 0-1

Lectures on general aeronautical engineering subjects by prominent authorities from the Bureau of Aeronautics, research laboratories and the industry.

Text: None.

Prerequisite: None.

**Ae-002(C) Aeronautical Lecture Series** 0-2

Lectures on electrical engineering subjects in connection with aeronautical engineering by prominent authorities from the Bureau of Aeronautics, research laboratories, and the industry.

Text. None.

Prerequisite: None.

**Ae-100(C) Basic Aerodynamics** 3-4

Properties of fluids; statics of fluids, flotation; Bernoulli's theorem; fluid velocity and pressure; pitotstatic tube; the venturi tube; cavitation; theory of lift; circulation; blade screws and propellers; viscosity; viscous flows; vortices; flow in pipes; flow through orifices; laminar and turbulent boundary layer flows; separation phenomena; surface friction; resistance of floating bodies; dynamics of compressible fluids. The practical work periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Text: Dodge, Thompson: Fluid Mechanics; Rouse: Elementary Fluid Mechanics.

Prerequisite: None.

**Ae-121(C) Technical Aerodynamics** 3-2

Characteristic flows and pressures about bodies; surface friction; wake drag; aerodynamic characteristics of airfoil sections; three-dimensional airfoil theory; induced drag; aspect ratio corrections; biplanes; interference drag; high lift devices; velocity polar; relative motion. The practical work periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Text: Warner: Airplane Design—Performance; Diehl: Engineering Aerodynamics; Hemke: Elementary Applied Aerodynamics; Pope: Wind Tunnel Testing.

Prerequisite: Ae-100(C).

**Ae-131(C) Technical Aerodynamics—Performance** 4-2

The aerodynamic characteristics of the airplane; The propeller and engine characteristics; sea level performance; performance at altitudes; superchargers; range and endurance; special performance problems; charts. The practical work periods are devoted to computations and performance analysis.

Text: Same as in Ae-121(C).

Prerequisite: Ae-121(C).

**Ae-132(B) Flight Analysis** 3-2

Parametric study of aircraft performance; flight test procedure; flight data reduction; special flight problems. Practical work periods are devoted to problems dealing with the above.

Text: Warner: Airplane Design—Performance; Diehl: Engineering Aerodynamics; Hamlin: Flight Testing.

Prerequisite: Ae-131(C).

**Ae-136(B) Aircraft Performance—Flight Analysis** 3-2

Aerodynamic characteristics of composite aircraft; propeller and engine characteristics; aircraft performance; range and endurance; special performance problems; performance parameters; flight test reduction and analysis. Practical work: analysis of performance of an aircraft will be made based upon wind tunnel tests in the laboratory; analysis of practical problems from flight test.

Text: Warner: Airplane Design—Performance; Diehl: Engineering Aerodynamics; Hemke: Elementary Applied Aerodynamics; Pope: Wind Tunnel Testing; Hamlin: Flight Testing.

Prerequisite: Ae-121(C).

**Ae-141(A) Dynamics I** 3-4

Fundamental definitions; the forces and moments on the entire airplane; the equations of motion; the moments of the wing, tail and other parts of the airplane; C. G. location, effect on static stability; neutral points; maneuver points; fixed control and free control stability; elevator, aileron rudder effectiveness; control design features; maneuverability and controlability; turns and loops. The laboratory work consists of wind tunnel experimentation and analysis of the above topics on models.

Text: Higgins: USNPS Notes; Perkins: Aircraft Stability and Controllability; Hamlin: Flight Testing.

Prerequisite: Ae-131(C).

**Ae-142(A) Dynamics II** 3-4

The Euler equations of motion; the moments of inertia of aircraft; the aerodynamic reactions and derivatives; solution of the symmetrical or longitudinal motion, analysis; solution of the asymmetrical or lateral motion, analysis; effect of control freedom, of controls and response; spins. The laboratory work consists of wind tunnel experimentation on models to study some of the above problems.

Text: Same as in Ae-141(A).

Prerequisite: Ae-141(A).

**Ae-146(A) Dynamics** 3-2

Fundamental definitions, forces and moments of composite aircraft; equations of motion; static stability and trim; effects of CG location; static margins; free control stability; dynamic longitudinal stability; dynamic lateral stability, force and moment; derivatives; stability charts; controllability; maneuverability; three-dimensional motions; spins.

The practical work consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Text: Same as in Ae-141(A).

Prerequisite: Ae-131(C) or Ae-136(B).

**Ae-151(B) Aeronautical Seminar** 2-0

This seminar is primarily in the technical aerodynamics of airplanes, on matters dealing especially with performance and test methods of the Test Pilot Training Division, NATC Patuxent River, Md. It is in preparation for the flight test program given in the fourth term.

Text: Dommasch, Sherby and Connolly: Airplane Aerodynamics.

Prerequisite: Ae-132(B).

**Ae-152(B) Aeronautical Seminar** 2-0

This is a continuation of Ae-151(B) in the same field.

Text: Same as Ae-151(B).

Prerequisite: Ae-151(B).

**Ae-200(C) Rigid Body Statics of Aircraft** 3-2

This course parallels Mc-101, extending the coverage of rigid body statics graphically and analytically to meet design requirements of aircraft components. Topics include: plane trusses, Maxwell diagrams, phantom members; compound and complex trusses; plane distributed force systems, composition and resolution, funicular polygons; centroids, moments of inertia, properties of aircraft sections; Mohr circle of inertia, ellipse of inertia, gyration ellipse; mass moments of inertia, application to aircraft, balance diagrams; simple, compound and complex space frames; load lines, shear and bending moment diagrams, inter-relationship; influence lines and elementary applications.

Text: Bruhn: Analysis and Design of Airplane Structures; Niles and Newell: Airplane Structures, 3rd Ed. Vol. 1; Timoshenko and Young: Statics.

Prerequisite: To be taken with Mc-101, with same prerequisites.

**Ae-211(C) Stress Analysis I** 4-0

This course is in continuity with Ae-200, and starts the analysis of elastic bodies, applied to aircraft structures and machines. Topics are: the elementary state of stress in ties, struts, shear members, circular shafts, simple beams, short beam-struts, cores, simple columns, thin cylinders; extended discussion of deflection of straight beams, frames with straight members; statically indeterminate cases using diagrammatic and moment-distribution methods; beams of variable I; trussed beams and wing cells.

Text: Bruhn: Analysis and Design of Airplane Structures; Niles and Newell: Airplane Structures, 3rd Ed., Vol. I; Timoshenko: Strength of Materials, Vol. I.

Prerequisite: Ae-200(C).

Ae-212(C) Stress Analysis II 4-2

This course is in continuity with Ae-211. It considers the general state of plane stress, stress flow in complicated components of air frames and machines, and the stability of continuous beam columns. Topics are: plane stress, principal stresses, Mohr circle of stress, stress ellipse; shear stress developed in bending, effect on critical beam stresses and deflection; shear flow in bending under transverse loads, center of twist; bending when neutral axis is not a principal axis or when load line is off the center of twist, beams with open or hollow sections; torsion of shafts of non-circular section, membrane analogy, torsional shear flow; torsion and bending; build-up beams, shear resistant webs, tension field webs, wooden beams; beam-columns, single and multi-panel charts; beam ties; polar diagrams.

Text: Bruhn: Analysis and Design of Airplane Structures; Niles and Newell: Airplane Structures, Vols. I and II; Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: Ae-211(C).

Ae-213(B) Stress Analysis III 4-2

This course is in continuity with Ae-212. It considers various forms of strain energy, and also curved bars and frames. Topics are: strain energy applications to impact loading; Castigliano theorem; displacements in trusses, trusses with redundant members; virtual energy, applications, Maxwell-Mohr method; law of reciprocal deflection, influence line applications; energy methods applied to buckling; curved bars, stresses and deflections; rotating machine parts.

Text: The same as in Ae-212(C).

Prerequisite: Ae-212(C).

Ae-214(A) Stress Analysis IV 3-0

This course is in continuity with Ae-213, and considers: the general three dimensional state of stress, strain and displacement, elastic equations; thin stiff plates under lateral load, bent to cylinder or in bending to mutually perpendicular directions; axially symmetrical plates; axially symmetrical membranes; discontinuity effects in shells; beams on elastic foundation, applications to cylinder and hemisphere or flat plate or hollow ring; thick walled spheres and cylinders under inner and outer pressures, application to rotating discs.

Text: The same as in Ae-213(B).

Prerequisite: Ae-213(B).

Ae-215(A) Advanced Stress Analysis 4-0

This is in continuity with Ae-214 and considers rectangular plates in pure bending, in bending and under middle surface loading; buckling, crippling; selected topics from theory of elasticity and plasticity; advanced stability considerations.

Text: The same as in Ae-214 plus Sechler and Dunn: Airplane Structural Analysis and Design.

Prerequisite: Ae-214(A).

Ae-311(C) Airplane Design I 2-4

Topics are: critical loading conditions, load-factors, V-g diagrams, strength envelopes, detail methods of layout and analysis of a light plane.

Practical work requirements are for the condition of high angle attack: prepare equipment list and balance diagram; correct airfoil characteristics for structural use; construct three-view drawing; run the balance calculation and the preliminaries to the wing design.

Text: Same as Ae-213(B); also Teichmann: Airplane Design Manual; Sechler and Dunn: Airplane Structural Analysis and Design; C.A.R. 04: C.A.M. 04: Navy Specifications and Manual.

Prerequisite: Ae-213(B).

Ae-312(B) Airplane Design II 2-4

Topics include: wing spar analysis, wing truss analysis, fuselage analysis including Maxwell diagram; design of one wing-spar on basis, shear-resistant web, tension-field web, composite spar of two materials; design of elevator torque tube in bending and twist for given loading condition; design of several members of the fuselage truss as columns and as ties; design of indicated fittings.

Text: Same as in Ae-311(C).

Prerequisite: Ae-311(C).

Ae-410(B) Thermodynamics (Aeronautical) 3-2

This course extends the study of fundamental thermodynamics in preparation for advanced work in aerothermodynamics and aircraft propulsion. Topics include one-dimensional compressible flow, internal combustion engine and turbine cycles and elements of heat transfer.

Text: Kiefer, Stuart and Kinney: Engineering Thermodynamics; Liepmann, Puckett: Aerodynamics of a Compressible Fluid; Stoever: Applied Heat Transmission; Keenan and Kaye: Gas Tables.

Prerequisite: ME-131(C).

**Ae-411(B) Aircraft Engines** 3-2

This course extends the study of combustion with particular reference to piston engine and gas turbine applications. Topics are: fuel mixtures; ignition; flame propagation and stability; utilization, conversion and mechanical aspects; survey of current engine design and construction.

**Text:** Lichty: Internal Combustion Engines; Taylor and Taylor: Internal Combustion Engines; USNPS stencils.

**Prerequisite:** Ae-410(B).

**Ae-421(B) Aircraft Propulsion** 3-2

Sea level and altitude performance characteristics of piston engines, propellers, turbo-jet and turbo-prop engines are analyzed. Topics are: maximum performance; cruise control; laboratory and flight testing; test data correction methods; aircraft performance review with particular reference to the propulsion system. The practical work of this course consists of supervised analysis of test data taken at various Naval Air Test Centers.

**Text:** Fraas: Aircraft Power Plants; Nelson: Airplane Propeller Principles; Air Technical Service Command: Jet Propulsion; USNPS stencils.

**Prerequisites:** Ae-411(B), Ae-131(C).

**Ae-431(A) Internal Flow in Aircraft Engines** 4-0

This is a fundamental course in the application of thermoaerodynamics to the study of flow in machines. Topics are: momentum theorem; thrust equations; gas turbine cycle analysis; flow equations; relative and absolute flow, relative flow in machines; energy equations; thermodynamic flow equations; axial-flow compressors; centrifugal compressors; axial-flow turbines; centrifugal turbines; control analysis of aircraft gas turbines.

**Text:** ATSC: Jet Propulsion; Zucrow: Jet Propulsion and Gas Turbines; USNPS stencils.

**Prerequisite:** Ae-503(A).

**Ae-451(C) Gas Turbines I** 3-0

A seminar on the theory, design, and control of gas turbines, stationary and marine.

**Text:** None.

**Prerequisite:** Ae-502(A), Ae-410(B) or ME-132(C).

**Ae-452(C) Gas Turbines II** 3-0

A seminar in continuation of Ae-451(C).

**Text:** None.

**Prerequisite:** Ae-451(C).

**Ae-501(A) Hydro-Aero Mechanics I** 4-0

This is the first of a sequence of four courses which study in detail the rational mechanics of fluid media. Topics are: vector calculus and aerodynamical applications; fluid kinematics and flow description; stream and velocity potential functions; dynamic equations for a perfect fluid; solution by scalar and vector methods; properties of elemental and combined flows; two-dimensional problems; use of complex numbers in flow description; conformal transformation; complex integration; Blasius equations; Kutta-Joukowski theorem; lift and pitching moment on an infinite wing.

**Text:** Glauert: Airfoil and Airscrew Theory; Streeter: Fluid Dynamics.

**Prerequisite:** Ae-131(C).

**Ae-502(A) Hydro-Aero Mechanics II** 4-0

Topics are: viscous fluids; Navier-Stokes equation and special solutions; Prandtl boundary layer theory; skin friction; Helmholtz vortex theory; the three-dimensional airfoil; induced velocity, angle of attack, drag; lift distribution; least induced drag; tapered and twisted airfoils; chordwise and spanwise load distribution, tunnel-wall effect; compressible fluids.

**Text:** Same as Ae-501(A).

**Prerequisite:** Ae-501(A).

**Ae-503(A) Compressibility I** 4-0

Topics are: compressible flow; thermodynamic fundamentals; adiabatic flow equations; propagation of plane disturbances; one-dimensional channel flow; oblique shock waves and shock reflections; optical measurement techniques; turbulance; turbulent boundary layer theory; transition.

**Text:** Kuethe and Schetze: Foundations of Aerodynamics; Liepmann and Puckett: Aerodynamics of a Compressible Fluid; Sauer: Theoretical Gas Dynamics.

**Prerequiste:** Ae-410(B), Ae-502(A).

**Ae-504(A) Compressibility II** 3-2

Topics are: two- and three-dimensional flow; two-dimensional linearized theory and application to airfoils in compressible flow; three-dimensional linearized theory; hodograph methods; method of characteristics; exact solutions in two-dimensional flow; transonic flow problems. Transonic and supersonic wind tunnel tests are conducted in conjunction with class discussion.

**Text:** Same as for Ae-503(A).

**Prerequisite:** Ae-503(A).

# CHEMISTRY

Ch Courses



**Ch-101(C) General Inorganic Chemistry** 3-2

The subject matter includes a consideration of general chemical principles such as the modern concept of the atom, kinetic theory, chemical equilibrium, chemical calculations, reaction rates and a brief discussion of specialized topics (corrosion, explosives, etc.) which are of interest to officers in the naval service. The laboratory work consists of experiments selected to illustrate principles discussed in the lecture.

Text: Hildebrand: Principles of Chemistry.

Prerequisite: None.

**Ch-102(C) General Inorganic Chemistry** 4-2

This course deals with the properties of substances and their atomic and molecular structure, weight relations in chemical reactions, valence, electronic structure and oxidation-reduction reactions. Theoretical topics considered include the properties of gases, reaction rates, and chemical equilibrium. The laboratory work consists of experiments in qualitative analysis on a semimicro scale, illustrating reactions and principles discussed in the lectures.

Text: Pauling: General Chemistry; Curtman: Introduction to Semimicro Qualitative Analysis.

Prerequisite: None.

**Ch-111(A) Fuel and Oil Chemistry** 2-2

The subject matter includes the chemistry, properties and production of fuels and lubricants; the theory of combustion and knocking; the theory of fluid film and boundary lubrication, the significance of tests on petroleum products and problems on the analysis of Orsat data and stoichiometry of combustion. The laboratory work includes conducting some of the standard tests on fuels and lubricants and problems on interpretation of data from Orsat analysis and combustion calculations.

Text: Gruse and Stevens: Chemical Technology of Petroleum; A.S.T.M.: Significance of Tests on Petroleum Products; Fed. Spec. VV-L791d.

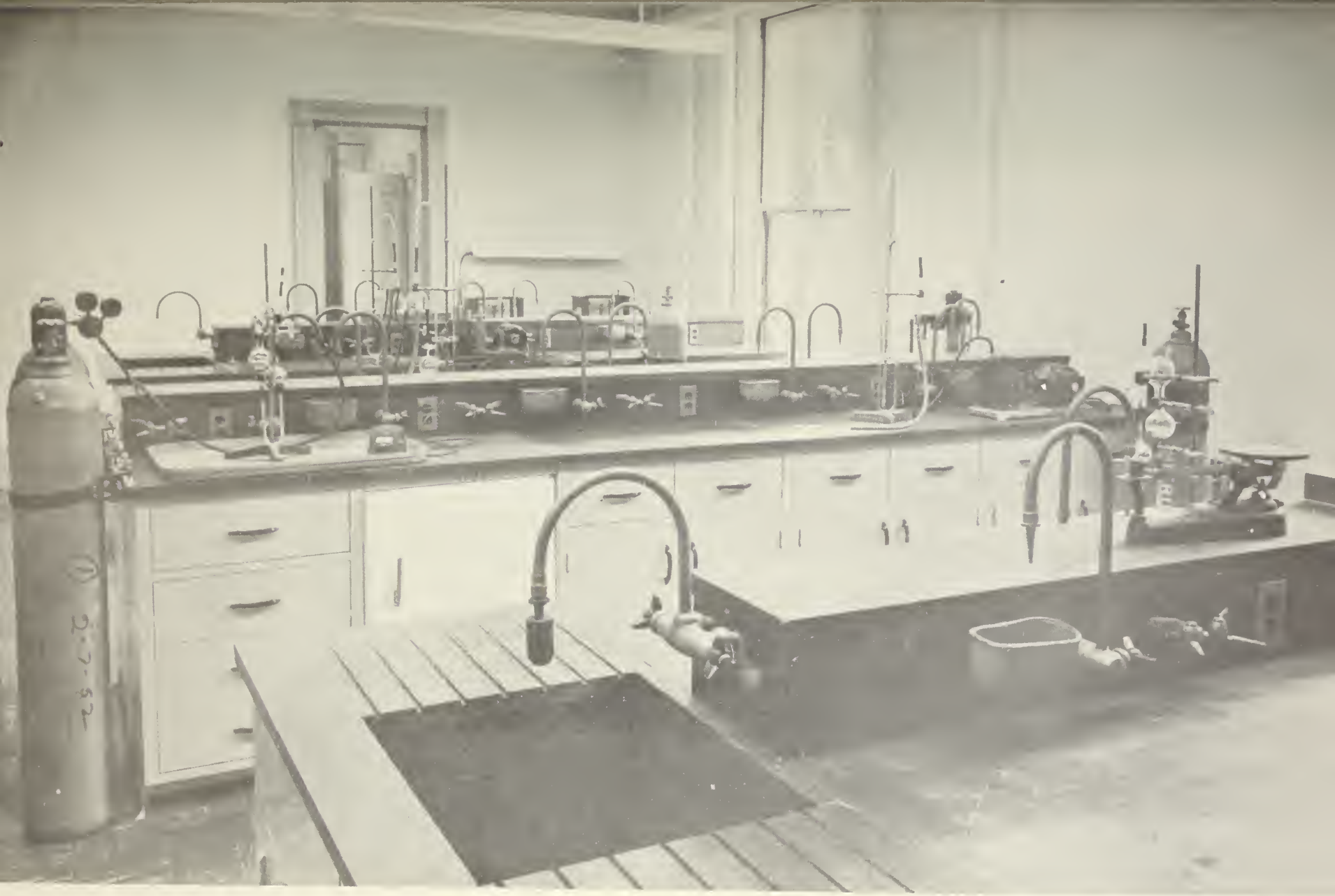
Prerequisite: Ch-101(C).

**Ch-121(B) General and Petroleum Chemistry** 4-2

The subject matter includes a consideration of chemical principles such as atomic structure, states of matter, ionization, chemical equilibria, etc.; and a survey of the chemistry, properties and production of fuels and lubricants. The theories of combustion, knocking and lubrication are presented. Study is made of the interpretation of results of standard test procedures and Orsat analysis. The laboratory work consists of experiments illustrating principles discussed in the lectures and performance of some of the standard tests on fuels and lubricants.

Text: Hildebrand: Principles of Chemistry; Gruse and Stevens: Chemical Technology of Petroleum; A.S.T.M.: Significance of Tests on Petroleum Producers; Federal Specifications for Lubricants and Liquid Fuels, VV-L-791d.

Prerequisite: None.



One of the Chemistry laboratories of the Engineering School.

Metallurgy classroom and laboratory of the Engineering School.

**Ch-213(C) Quantitative Analysis** 2-3

This course deals with the theoretical principles underlying analytical chemical methods, and the calculations involved in quantitative determinations. The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Pierce and Haenisch: Quantitative Analysis.

Prerequisite: Ch-102(C).

**Ch-221(C) Qualitative Analysis** 3-2

This is the first part of a course in analytical chemistry and includes the treatment of the theory of ionization, chemical equilibrium, solubility product, complex ion formation and oxidation-reduction, reactions, as they apply to qualitative analysis. The laboratory work consists of the separation and detection of selected ions on a semimicro scale.

Text: Curtman: Introduction to Semimicro Qualitative Analysis.

Prereqisite: Ch-101(C) or Ch-121(B).

**Ch-231(C) Quantitative Analysis** 2-3

This course is a continuation of Ch-221, and deals with the theoretical principles and calculations involved in quantitative analysis. The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Pierce and Haenisch: Quantitative Analysis.

Prerequisite: Ch-101(C) or Ch-121(B): Ch-221 (C).

**Ch-301(C) Organic Chemistry** 3-2

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, a brief summary of aliphatic and aromatic compounds. The laboratory work includes both preparative experiments and experiments illustrating reactions discussed in the lectures.

Text: Fuson, Connor, Price and Snyder: Organic Chemistry.

Prerequisite: Ch-101(C) or Ch-121(B).

**Ch-311(C) Organic Chemistry** 3-2

The first half of a course in organic chemistry, consisting of the study of the properties and reactions of aliphatic compounds. The laboratory work is designed to illustrate important reactions of organic compounds.

Text: Brewster: Organic Chemistry.

Prerequisite: Ch-101(C).

**Ch-312(C) Organic Chemistry** 3-2

The second half of a course in organic chemistry, dealing chiefly with aromatic compounds, following Ch-311(C). Organic synthetic methods are emphasized. The laboratory work includes the preparation of selected organic compounds.

Text: Brewster: Organic Chemistry.

Prerequisite: Ch-311(C).

**Ch-315(C) Organic Chemistry** 3-0

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, as a basis for work in the biological sciences. The laboratory work furnishes discriptive material illustrating reactions discussed in the lectures.

Text: Fuson, Connor, Price and Snyder: Organic Chemistry.

Prerequisite: Ch-120(C); Ch-213(C).

**Ch-321(A) Organic Qualitative Analysis** 2-2

This course consists of the identification of organic compounds on the basis of physical properties, solubility behavior, classification reactions and the preparation of derivatives.

Text: Shriner and Fuson: Identification of Organic Compounds.

Prerequisite: Ch-301(C); Ch-312(C) or Ch-315 (C).

**Ch-322(A) Organic Chemistry, Advanced** 3-2

This course is concerned principally with reactions involved in the synthesis of organic compounds, with particular attention to reaction mechanisms and electronic explanations of the behavior of organic compounds.

Text: Fuson: Advanced Organic Chemistry; Alexander: Principles of Ionic Organic Reactions.

Prerequisite: Ch-301(C); Ch-312(C) or Ch-315(C).

**Ch-323(A) The Chemistry of High Polymers** 3-0

This course deals with the synthetic and structural aspects of high polymer chemistry, and includes discussion of both synthetic and natural high polymers.

Text: Ritchie: Chemistry of Plastics and High Polymers.

Prerequisite: Ch-301(C); Ch-312(C) or Ch-315(C); Ch-512(A).

**Ch-401(A) Physical Chemistry** 3-2

This is a fundamental course in physical chemistry for ordnance students. The subject matter includes topics such as gases, liquids, solutions, thermochemistry and chemical thermodynamics, with particular emphasis placed on chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion calculations, equilibria in explosion products adiabatic flame temperatures, etc., form an integral part of the course. The laboratory work consists of experiments illustrating principles discussed in the lectures.

Text: Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams: Experimental Physical Chemistry.

Prerequisite: Ch-101(C) or equivalent; Ch-631(A) or equivalent.

**Ch-411(C) Physical Chemistry** 3-2

This course involves a study of the physicochemical properties of matter and the laws governing chemical behavior. Topics include gases, solids, molecular structure, thermodynamics, thermochemistry, liquids and solutions. The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Text: Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams, Experimental Physical Chemistry.

Prerequisite: Ch-101(C) or Ch-121(B).

**Ch-412(C) Physical Chemistry** 3-2

This course is a continuation of Ch-411(C). Topics include chemical equilibrium, chemical kinetics, electrical conductance, electromotive force, colloids and atomic and nuclear structure. The laboratory work consists of experiments designed to illustrate principles descussed in the lectures.

Text: Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams: Experimental Physical Chemistry.

Prerequisite: Ch-411(C).

**Ch-413(A) Physical Chemistry (Advanced)** 2-2

A graduate course in selected topics in physical chemistry. Electronic configurations, dipole moments, physical chemistry of the solid state and the liquid state, etc. The laboratory work consists of experiments designed to supplement the material covered in the classroom.

Text: None.

Prerequisite: Two terms of Physical Chemistry, one term of Thermodynamics.

**Ch-442(C) Physical Chemistry** 4-2

This course involves a study of the laws governing the chemical behavior and the physicochemical properties of matter. Some of the topics considered are gases, liquids, solids, solutions, thermochemistry, chemical thermodynamics, chemical equilibrium, chemical kinetics, electrochemistry and colloids.

Text: Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams: Experimental Physical Chemistry.

Prerequisite: Ch-101(C) or equivalent.

**Ch-520(B) Plastics** 2-2

The subject matter includes an introductory study of the nature and types of plastics, their properties, applications, and limitations as engineering material. The laboratory exercises consist of the preparation of typical plastics, a study of their physical and chemical properties and identification tests.

Text: Richardson and Wilson: Fundamentals of Plastics.

Prerequisite: Ch-101(C) or Ch-121(B).

**Ch-521(A) Plastics** 3-2

The subject matter includes a study of the nature and types of plastics, including silicone-base plastics and rubbers, both natural and synthetic. Special emphasis is placed on application, limitations as engineering materials, and correlation between properties and chemical structure. The laboratory exercises consist of the preparation of typical plastics, a study of their properties, and identification tests.

Text: Richardson and Wilson: Fundamentals of Plastics.

Prerequisite: Ch-101(C) or Ch-121(B).

**Ch-531(A) Physical Chemistry (for metallurgical students)** 2-0

A continuation of the study of physical chemistry, emphasizing certain aspects of particular importance in metallurgy. Chemical equilibria in reduction processes, in deoxidation and in carburizing-decarburizing; principles of controlled atmospheres; activity and activity coefficients in metal solutions; concentration gradients and diffusion effects. Numerical problems form an integral part of the course.

Text: None.

Prerequisite: Physical Chemistry and Mt-202(C).

**Ch-541(A) Reaction Motors** 2-2

The subject matter includes the theory and design of rocket motors and thermal jet engines, nozzles,

solid and liquid propellants and the applications of these devices to military uses. Numerical problems form an integral part of the course.

**Text:** Sutton: Rocket Propulsion Elements.

**Prerequisite:** Ch-101 or equivalent and one term of Thermodynamics.

**Ch-551(A) Radiochemistry** 2-2

A seminar course with discussions on the important aspects of radioactivity from the standpoint of the chemical transformations which accompany it and which it may induce; the possible health hazards associated with radioactivity, safety measures and decontamination problems; techniques for measurement and study of ionizing radiation.

**Text:** None.

**Prerequisite:** Physical Chemistry.

**Ch-561(A) Physical Chemistry** 3-2

This is a fundamental course in physical chemistry for students who are non-chemistry majors. The subject matter includes topics such as gases, liquids, thermochemistry, chemical thermodynamics, with particular emphasis placed on chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion calculations, equilibria in combustion products, flame temperatures, etc., form an integral part of the course. The laboratory work consists of experiments illustrating principles discussed in the lectures.

**Text:** Daniels: Outlines of Physical Chemistry; Daniels, Mathews and Williams: Experimental Physical Chemistry.

**Prerequisite:** Ch-111(A) or 121(B).

**Ch-581(A) Chemistry of Special Fuels** 2-2

A brief survey of the organic and physical chemistry necessary for an appreciation of the problems associated with special fuels. The nature of conventional fuels and of high-energy fuels, their limitations, and possible future developments; methods of reaction rate control; etc.

**Text:** None.

**Prerequisite:** Physical Chemistry.

**Ch-591(A) Blast and Shock Effects** 3-0

Propagation of shock waves in homogeneous media; Scaling laws for damage for air, underwater and underground bursts; thermal radiation and incendiary effects; ionizing radiation effects; principles of protection of personnel against damage.

**Text:** AFSWP-Hirschfeller: The Effects of Atomic Weapons.

**Prerequisite:** Physical Chemistry, Thermodynamics.

**Ch-611(C) Thermodynamics** 3-2

A study of the fundamentals of thermodynamics; the concept of energy and transformations; thermodynamic properties of substances, ideal gases; thermochemistry. Numerical problems form an integral part of the course.

**Text:** Kiefer, Stewart, and Kinney: Principles of Engineering Thermodynamics, 2nd Ed.; Smith: Introduction to Chemical Engineering Thermodynamics; Perry: Chemical Engineers Handbook; Keenan and Keyes: Thermodynamic Properties of Steam; Keenan and Kaye: Gas Tables.

**Prerequisite:** Ch-101(C).

**Ch-612(C) Thermodynamics** 3-2

A continuation and extension of Ch-611, with application of the principles of thermodynamics to the unit operations and unit processes of chemical engineering practice. Numerical problems are used extensively in illustrating principles.

**Text:** Smith: Introduction to Chemical Engineering Thermodynamics; Perry: Chemical Engineering Handbook; Keenan and Keyes: Thermodynamics Properties of Steam; Keenan and Kaye: Gas Tables.

**Prerequisite:** Ch-611(C).

**Ch-613(A) Chemical Engineering Thermodynamics** 3-2

The subject matter is an extension of previous studies in mechanical engineering thermodynamics, to include the thermodynamic analysis and solution of chemical engineering problems. It is designed for non-chemical majors. The course includes a specialized treatment of the thermal and thermodynamic properties of materials; thermo-chemistry; equilibrium and the phase rule; phase relations; chemical equilibria and energy relations, particularly at higher temperatures and pressures. Strong emphasis is placed on numerical or quantitative application of principles by solution of problems.

**Text:** Smith: Introduction to Chemical Engineering Thermodynamics; Perry: Chemical Engineers Handbook.

**Prerequisite:** One term of Physical Chemistry and one term of Thermodynamics.

Ch-631(A) **Thermodynamics** 3-2

An extension of Ch-711(C) to include thermodynamic analyses which are fundamental and requisite to the solution of many ordnance problems.

In addition to treatment of the First and Second Laws of Thermodynamics, the subject matter includes thermodynamic properties of matter, compression and expansion processes, phase equilibria, criteria, of equilibrium, fugacity, chemical reaction equilibria. This course supplies a prerequisite for subsequent study of rocket motors or interior ballistics.

Text: Robinson: Thermodynamics of Firearms; Smith: Introduction to Chemical Engineering Thermodynamics.

Prerequisite: Ch-711(C) or Ch-701(C).

Ch-701(C) **Chemical Engineering Calculations** 3-2

This course is especially designed to develop facility in the recognition and solution of engineering problems involving mass and energy relationships in chemical and physical-chemical reactions. Problems based on combustion, distillation, absorption, evaparotion, crystallization, humidification and other unit operations and processes are dealt with. Problems are chosen from engineering practice whenever possible.

Text: Hougen and Watson: Chemical Process Principles, Part I; Lewis and Radasch: Industrial Stoichiometry; Perry: Chemical Engineers Handbook.

Prerequisite: Ch-101(C) or Ch-121(B).

Ch-711(C) **Chemical Engineering Calculations** 3-2

An introductory course in chemical engineering. Stoichiometry; material and energy balances in various unit operations and in typical chemical reactions, processes and plants; principles of thermochemistry; composition of equilibrium mixtures. Numerical problems selected from ordnance applications form an integral part of the course.

Text: Hougen and Watson: Chemical Process Principles, Part I; Robinson: Thermodynamics of Firearms.

Prerequisite: None.

Ch-800(A) **Chemistry Seminar** 2-0

This course involves library investigations of assigned topics, and reports on articles in the current technical journals.

Text: None.

Prerequisite: None.

# COMMUNICATIONS

Co Courses



**Co-101(C) Typing and Radio Code** 0-4

This course is the first in the operating communication series. It is designed to teach student officers the touch system of typing in order to facilitate participation in courses Co-102(C), Co-114(C) and to provide a necessary basic skill of communication officers. When students attain a typing proficiency of 30 WPM they are started on radio code.

Text: Lessenbury: 20th Century Typing.

Prerequisite: None.

**Co-102(C) Radio Code and W/T Procedure** 0-3

This course is a continuation of Co-101(C) and is planned to bring student operating ability in Morse Code up to a level that will permit them to operate on slow speed CW circuits. Actual operation of slow speed CW circuits provides experience in log keeping, message servicing and circuit discipline.

Text: Classified official publications.

Prerequisite: Co-101(C).

**Co-103(C) Visual and Voice Procedure** 1-3

This course is the third in the operating communication series and is designed to develop student ability by actual operation in sending and receiving flashing light, flaghoist, semaphore and voice radio.

Text: Classified official publications.

Prerequisite: Co-102(C).

**Co-104(C) Military Communication Organizations** 1-1

This course is the final one of the operational communication series. It covers the organization of the Naval Communication Service, afloat and ashore. Laboratory periods are devoted to seminar presentation of papers prepared by each student on a communication subject; and to lectures by representatives of other military communication organizations.

Text: Classified official publications.

Prerequisite: None.

**Co-110(C) Radio and Visual Procedure** 2-2

This course presents the principles of effective message drafting, procedures of radio telegraph, visual and voice communication; use of operating signals, call signs, routing indicators and delivery groups.

Text: Classified official publications.

Prerequisite: None.

**Co-111(C) Tape Relay and Toll Traffic Procedures** 2-1

This course presents tape relay procedures and instructions for handling and abstracting toll traffic.

Text: Classified official publications.

Prerequisite: None.

**Co-112(C) International and Commercial Communications** 1-1

This course surveys international communication agreements, world-wide frequency allocations and navigational radio aids. In addition, the study of NATO Naval Communication Instructions and Wireless Organization familiarizes student officers with working communication plans of NATO naval com-

munications. The operations of various commercial companies and their inter-relationship with the U. S. Naval Communication Service is presented through the medium of lectures.

Text: Classified official publications.

Prerequisite: None.

**Co-113(C) Correspondence and Mail** 1-1

This course consists of lectures and written exercises on office management, filing, and correspondence with a brief summary of the duties of the Communication Officer in connection with the Postal Service.

Text: Classified official publications.

Prerequisite: None.

**Co-114(C) Cryptosystems** 0-3

This course gives practical instruction in the selection and manipulation of cryptographic aids and devices.

Text: Classified official publications.

Prerequisite: Co-101(C).

**Co-120(C) Communication Security and Registered Publication Handling** 2-1

This course presents the rules governing the physical security of classified matter. Special emphasis is placed on the Registered Publication System and the detailed duties of the Registered Publication Custodian.

Text: Classified official publications.

Prerequisite: None.

**Co-121(C) Communication Planning** 2-1

This course is devoted entirely to the thorough study of the U. S. Naval Basic Communication Policy and Plan.

Text: Classified official publications.

Prerequisite: None.

**Co-122(C) Communication Planning** 2-2

This course takes up the application of the U. S. Naval Basic Communication Policy and Plan to the actual preparation of Communication Plans, including the usual appendices for typical Surface Action, Carrier Task Force, Escort of Convoy and Submarine Force Operations.

Text: Classified official publications.

Prerequisite: Co-121(C).

**Co-123(C) Communication Planning** 1-2

This course completes the formal study of communication planning. It covers the application of principles previously studied to the development of typical communication plans for amphibious operations. The completion of this course realizes the objective of furnishing the student with background knowledge required to draft a communication plan to support any mission assigned or derived.

Text: Classified official publications.

Prerequisite: Co-121(C), Co-122(C), Co-133(C).

**Co-131(C) Tactics** 2-2

This course is the first of a series designed to give the student officer a working knowledge of naval tactics and effective tactical publications. This course covers the maneuvering board and its uses, the basic rules for ship and formation maneuvers, the function of CIC, and screening instructions. The intimate relationship between tactics and communications is stressed in all courses of this series.

Text: Classified official publications.

Prerequisite: None.

**Co-132(C) Tactics** 2-2

This course, the second of the tactical series, applies the principles learned in Co-131(C) to the various naval striking and support forces. The principles of scouting are also studied.

Text: Classified official publications.

Prerequisite: Co-131(C).

**Co-133(C) Tactics** 2-2

This course, the third in the tactical series, introduces the student officer to the tactical problems involved in amphibious operations and procedures developed to solve them. It provides a foundation for Co-123(C).

Text: Classified official publications.

Prerequisite: Co-131(C), Co-132(C).

**Co-134(C) Tactics** 2-2

This course, the final one in the tactical series, covers submarine warfare, anti-submarine warfare, and escort of convoy.

Text: Classified official publications.

Prerequisite: Co-131(C), Co-132(C).

**Co-135(C) Correspondence Course in Strategy and Tactics** 0-0

The student officer is required to complete at least four assignments of the U. S. Naval War College Correspondence Course in Strategy and Tactics prior to the completion of his instruction at the Postgraduate School. This provides experience in using the Armed Forces Estimate Form and the Armed Forces Operation Plan Form.

**Co-150(C) Communication Procedures**
80 classroom hours

This course presents the student officer with the instructions for the various means of communications, including the principles of effective message drafting and the use of operating signals, call signs and procedure signs. Toll traffic and the arrangement and use of the Allied Naval Signal Book are also covered.

Text: Classified official publications.

Prerequisite: None.

**Co-151(C) Communication Security**
32 classroom hours

This course emphasizes the need for adequate security measures and presents the rules governing physical security, communication security, and the duties of the Registered Publication Custodian.

Text: Classified official publications.

Prerequisite: None.

**Co-152(C) Cryptography** 34 classroom hours

This course presents the overall cryptoplan of the U. S. Navy and instruction in the use of cryptoaids. Use of authentication and recognition signals is also included.

Text: Classified official publications.

Prerequisite: None.

**Co-153(C) Communication Plans**
62 classroom hours

This course is primarily a study of the basic U. S. Naval Communication Policy and Plan and the U. S. Navy Communications Frequency Plan. The principles of typical communication plans are studied with emphasis on those for carrier task force and amphibious operations. The NATO communication plan is also included. Practical works are used extensively to explain and emphasize material covered.

Text: Classified official publications.

Prerequisite: None.

**Co-154(C) Miscellaneous Communication Subjects**
20 classroom hours

This course introduces the student to the administrative subjects of fleet and shipboard organizations, Navy correspondence and filing practices, and the U. S. Postal Service. Familiarization with communication equipments and elementary electronics is also included.

Text: Classified official publications.

Prerequisite: None.

**Co-155(C) Typing, Radiotelegraph Code and Radiotelephone Operating** 32 classroom hours

This course teaches the student officer the touch typing system. It provides basic instruction in radiotelegraph code and gives practical operating experience in radiotelegraph and radiotelephone. The time devoted to radiotelegraph is varied as necessary to obtain the maximum of this training commensurate with the individual student's intitial proficiency in typing and his progress during the first part of the course.

Text: Classified official publications.

Prerequisite: None.

**Co-160(C) Tactics** 76 classroom hours

By study of the principal tactical publications of the U. S. Navy, motion pictures thereon, and practical works, the student officer acquires sufficient knowledge and background to effectively use the Navy's basic tactical publications and to fully appreciate the relationship between communications and tactical operations.

Text: Classified official publications.

Prerequisite: None.

# CRYSTALLOGRAPHY

Cr Courses



**Cr-271(B) Crystallography and X-Ray Techniques** 3-2

This course is designed for the student in metallurgy, chemistry, physics, and allied fields, to supply the requisite background for courses which embody such concepts as the physics of the solid state; for example, the physics of metals, optical and x-ray identification of chemical compounds, such as explosive mixtures and studies concerning crystal structures in general. The student is first introduced to the fundamental concepts of crystallography, including: symmetry, point groups, plane lattices, space lattices, space groups, coordinate systems, indices, crystal classes, crystal systems, common forms and combinations in the various systems. The stereographic projection is then studied. With this foundation, some time is spent on a discussion of the crystal structure of the elements, metals, alloys, and inorganic compounds.

The latter part of the course is devoted to acquainting the student with modern x-ray diffraction and radiographic apparatus and techniques, including: the theory of x-ray diffraction, the Bragg equation, powder methods, single crystal and moving film methods, high temperature diffraction technique as applied to obtaining phase diagrams, back reflection and transmitted beam methods, and practical applications of these methods. The laboratory work includes: a study of crystal models for symmetry, forms, and combinations; the construction of stereographic projections; and actual practice in the making and interpreting of x-ray diffraction photographs.

Text: Dana, Ford: Textbook of Mineralogy; Barrett: Structure of Metals.

Prerequisite: Ch-101(C).

**Cr-301(B) Crystallography and Mineralogy** 3-4

This course is designed primarily for the student who will continue with courses in mineralogy, geology, and petrology. The student is first introduced to the fundamental concepts of crystallography, including: symmetry; point groups; plane lattices; space lattices; space groups; coordinate systems; indices; crystal classes; crystal systems; common form and combinations in the various systems and classes. The stereographic projection is then studied with special reference to its application to crystallographic problems. The theory of x-ray diffraction and the application of x-ray powder methods is taken up as applied to identification of minerals. The remainder of the time is spent on the description of some fifty of the more common minerals. The laboratory work includes a study of crystal models for symmetry forms, and combinations; the practical application and construction of stereographic projections; determination of minerals by x-ray powder diffraction patterns; and, as time permits, a start is made in the identification of minerals.

Text: Dana, Ford: Textbook of Mineralogy.

Prerequisite: Ch-101(C).

**Cr-311(B) Crystallography and Mineralogy** 3-2

Subject matter similar to Cr-301, but designed for students who will continue with courses in Chemistry.

Text: Dana, Ford: Textbook of Mineralogy.

Prerequisite: Ch-101(C).

# ELECTRICAL ENGINEERING

EE Courses



**EE-111(C) Fundamentals of Electrical Engineering** 3-2

This course presents a basic treatment of the general theory of electric and magnetic circuits. Electrical units, Ohm's law, and Kirchhoff's laws are studied in detail. The magnetic field and the magnetic properties of iron and steel are included.

Text: Dawes: Electrical Engineering, Vol. I.

Prerequisite: Differential and Integral Calculus, Elementary Physics.

**EE-151(C) DC Circuits and Fields** 3-4

This course provides a thorough foundation in electricity and magnetism, with the major emphasis on electric and magnetic circuits. The basic laws are given and many problems and laboratory experiments are assigned to illustrate the theory. The course serves as a preparation for further study in electrical engineering.

Text: Corcoran: Basic Electrical Engineering.

Prerequisite: Differential and Integral Calculus, Elementary Physics.

**EE-171(C) Electric Circuits and Fields** 3-4

This course provides a very thorough foundation in electricity and magnetism for a curriculum majoring in electrical science. The basic laws are given in detail. Many problems are assigned and laboratory experiments are performed to illustrate the classroom theory. The course serves as a foundation for further advanced study.

Text: Corcoran: Basic Electrical Engineering.

Prerequisite: Differential and Integral Calculus, Elementary Physics.

**EE-231(C) DC Machines and AC Circuits** 3-2

This course presents the general principles of DC machines, both motors and generators, and of their control and application. The qualitative characteristics of the various machines are developed from basic principles; then a study of the theory of alternating currents is begun. Experiments are performed to demonstrate the general machine characteristics and the use of control devices.

Text: Dawes: Electrical Engineering, Vols. I and II.

Prerequisite: EE-111(C).

**EE-241(C) Alternating Current Circuits** 3-2

This course presents the essential theory for those curricula that do not require an extensive coverage. It consists of an elementary treatment of single-phase series and parallel circuits, resonance, vector representation and vector algebra. The most commonly used network theorems, non-sinusoidal wave analysis, coupled circuits, and balanced polyphase circuits are presented. Laboratory and problem work illustrate the basic theory.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-151(C).

**EE-251(C) Alternating Current Circuits** 3-4

This course presents the essential theory for those curricula that do not require an extensive coverage. It consists of an elementary presentation of single-phase series and parallel circuits, resonance, vector representation and vector algebra, the most commonly used network theorems, non-sinusoidal wave analysis, coupled circuits and balanced polyphase circuits. Laboratory and problem work illustrate the basic theory.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-151(C).

**EE-271(C) Alternating Current Circuits** 3-2

This course and EE-272, which follows, present in a thorough way the basic theory of the alternating current circuit for those curricula that require an extensive coverage. The theory is developed from fundamental physical principles. The course covers single-phase series and parallel circuits, resonance, vector algebra and vector representation of electrical magnitudes, network theorems, non-sinusoidal wave analysis, balanced polyphase circuits and power measurements in polyphase circuits. Many problems and laboratory work illustrate the basic theory.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-171(C).

**EE-272(C) Alternating Current Circuits** 2-2

This course is a continuation of EE-271. It completes the basic theory of the alternating current circuit for those curricula requiring a thorough preparation for further advanced study. The course includes unbalanced polyphase circuits, instruments and measurements, coupled circuits, bridge theory and symmetrical components. Many problems and laboratory work illustrate the basic principles.

Text: Kerchner and Corcoran: Alternating Current Circuits.

Prerequisite: EE-271(C).

**EE-273(C) Electrical Measurements I** 2-3

A basic introduction to the measurement of fundamental quantities such as current, voltage, capacitance, inductance, and the magnetic properties of materials is presented. A thorough treatment of the conventional direct-current bridges is given, along with methods for measuring high resistance. Characteristics of direct-current galvanometers are studied in detail. Potentiometer principles are studied and commercial types are used in typical applications. The theory, construction, and application of direct-current indicating instruments are given detailed consideration.

Text: Stout: Basic Electrical Measurements.

Prerequisite: EE-272(C).

**EE-274(B) Electrical Measurements II** 2-3

This course is a continuation of EE-273(C). The most commonly used alternating current bridge circuits, components, and accessories are considered in detail. Application of these bridges in the measurement of resistance, inductance, capacitance and mutual inductance is the basis for the laboratory work in this course. Bridges for the determination of the properties of dielectrics are studied. Measurements to determine dielectric characteristics are made in the laboratory.

Text: Stout: Basic Electrical Measurements.

Prerequisite: EE-273(C).

**EE-314(C) AC and DC Machinery** 3-4

This course presents a brief treatment of electrical machines for those curricula that do not require advanced work in electrical engineering. It consists of an elementary study of DC machines and their characteristics, the alternator, the synchronous motor, and the induction motor. Laboratory and problem work illustrate the principles.

Text: Dawes: Electrical Engineering, Vols. I and II.

Prerequisite: Es-111(C), Es-112(C).

**EE-351(C) DC Machinery** 2-2

This course presents the fundamentals of direct current machinery with emphasis upon operating

characteristics and applications. The external characteristics are developed from basic relations. Problems are assigned and laboratory work supplements that of the classroom.

Text: Dawes: Electrical Engineering, Vol. I.

Prerequisite: EE-151(C) or EE-171(C).

**EE-371(C) DC Machinery** 3-2

This course gives a thorough presentation of the theory and performance of direct current machines and control devices. Armature windings, armature reaction and commutation are fully covered. The operating characteristics of generators and motors are developed from basic relations so as to provide a foundation for subsequent work in design. Problems are assigned to illustrate the application of the theory. Laboratory work supplements the work of the classroom.

Text: Langsdorf: Principles of DC Machines.

Prerequisite: EE-171(C).

**EE-451(C) Transformers and Synchros** 2-2

This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive treatment. It covers single phase transformer principles and operating characteristics including the auto-transformer, constant-current transformer, and special transformers. Also, polyphase transformer connections and the polyphase transformer are covered. Single phase and polyphase synchro construction features, operating characteristics, and basic theory are included. A comprehensive analysis is included of the voltage, current and torque relations for regular and fault synchro conditions. Laboratory and problem work illustrate the theory of the classroom.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-251(C).

**EE-452(C) Polyphase Transformers, Synchronous Machines and Induction Motors** 3-4

This course is a continuation of EE-451(C). It completes a general presentation of AC machinery for those curricula that do not require an extensive treatment. Alternators, synchronous motors, polyphase and single-phase induction motors are presented. A brief survey of induction generators, induction regulators and the commutator type AC motor is included. Laboratory and problem work illustrate the basic theory.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-451(C).

**EE-455(C) Asynchronous Motors** 2-2

This course gives an elementary presentation of the principles and operating characteristics of the induction motor and of single-phase commutator motors. Emphasis is placed upon the unbalanced operation of the two-phase symmetrical induction motor. Laboratory and problem work supplement the theory.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-451(C).

**EE-461(C) Transformers and Synchros** 3-2

This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive coverage. It presents single-phase transformer principles and operating characteristics, including the auto-transformer and special transformers. Windings for synchros and induction motors, single-phase and polyphase synchro construction features, operating characteristics and basic theory are included. A comprehensive analysis of the voltage, current and torque relations for regular and fault synchro conditions is presented. Laboratory and problem work illustrate the theory of the classroom.

Text: Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-241(C).

**EE-462(B) Asynchronous Motors and Special Machines** 4-2

This course gives an elementary presentation of the principles and operating characteristics of the induction motor and of single-phase commutator motors. Emphasis is placed upon the unbalanced operation of the two-phase symmetrical induction motor. It also presents the theory of the amplidyne-motor, rototrol-motor, generator-motor and motors operating under the conditions of variable voltage and current supply. Emphasis is given the transfer function (ratio of torque output to voltage input) necessary as a preparation for work in servomechanism. Laboratory and problem work supplement the theory.

Text: Lecture Notes; Hehre and Harness: Electrical Circuits and Machinery, Vol. II.

Prerequisite: EE-461(C).

**EE-471(C) Transformers, Asynchronous Machines and Synchros** 3-4

This course gives a thorough presentation of the principles and operating characteristics of transformers, asynchronous machines and synchros for the curricula requiring advanced electrical engineering work leading to design. In detail, the basic theory of single-phase and polyphase transformers, including auto transformers, constant current and special transformers is presented. Polyphase induction motor principles, including armature windings, voltage and mmf waves and operating characteristics are emphasized. Induction generators, single-phase induction motors, and the commutator type AC motor are included. Synchro theory with an analysis of the voltage, current and torque relations for normal and fault conditions is presented. Laboratory and problem work supplement the basic theory.

Text: Bryant and Johnson: AC Machinery.

Prerequisite: EE-272(C).

**EE-472(C) Synchronous Machines** 3-4

This course is a continuation of EE-471. Alternator and synchronous motor characteristics are presented on the basis of cylindrical rotor and two-reaction theories. Armature winding, voltage and mmf waves, armature reaction, load saturation curves, regulation and losses are emphasized. Parallel operation, frequency changers and synchronous converters are presented. Many problems and laboratory work supplement the basic theory.

Text: Bryant and Johnson: AC Machinery.

Prerequisite: EE-471(C)

**EE-473(B) Synchros** 2-2

This course presents a thorough treatment of the basic theory of synchros and synchro systems for curricula requiring preparation for further advanced study. The mathematical analysis of single-phase and polyphase synchro systems covers voltage, current and torque relations for normal and fault conditions, vector diagrams and equivalent circuits. Problems and laboratory work supplement the theory. The course is presented in lecture form.

Text: None.

Prerequisite: EE-272(C).

**EE-551(B) Transmission Lines and Filters** 3-2

This course presents the essential basic principles of transmission lines and filter. The topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and Pi sections, constant K and M derived sections and composite filters. Problems and laboratory work are included.

Text: Ware and Reed: Communication Circuits.

Prerequisite: EE-251(C).

**EE-571(B) Transmission Lines and Filters** 3-4

This course presents a thorough coverage of the basic theory of transmission lines and filters for the curricula requiring preparation for further advanced work. The topics covered in detail are transmission line parameters, infinite line, open and shorted lines, reflection, transmission line efficiency, impedance transformation, stubs, T and Pi section, constant K and M derived sections and composite filters. Problems and laboratory work supplements the theory.

Text: Ware and Reed: Communication Circuits.

Prerequisite: EE-271(C), EE-272(C).

**EE-611(B) Servomechanisms** 3-4

This course presents the essential basic principles of servomechanisms. The topics covered are the amplidyne, the elements of electrical transients, the synchro, and an introduction to servomechanism devices. Problems and laboratory work supplement the classroom theory.

Text: Kurtz and Corcoran: Introduction to Electric Transients.

Prerequisite: EE-314(C).

**EE-651(B) Transients and Servos** 3-4

This course presents the essential basic principles of electrical transients and servomechanisms. The topics covered are DC and AC transients in series, parallel, series-parallel and coupled circuits using the methods of differential equations and Heaviside. The Laplace transform method is introduced. An analysis is given of servomechanisms with viscous damping and differential and integral control, using the transfer function method. Problems and laboratory experiments illustrate the theory.

Text: Gardner and Barnes: Transients in Linear Systems; Lauer, Lesnick and Matson: Servomechanism Fundamentals.

Prerequisite: EE-451(C).

**EE-655(B) Filters and Transients** 3-2

This course presents the essential basic principles of filters and electrical transients. For filters the topics are T and Pi sections and composite filters.

In transients the topics include DC and AC transients in series, parallel, series-parallel and coupled circuits, using the methods of differential equations and Heaviside. The Laplace transform method is introduced. Problems are assigned.

Text: Kerchner and Corcoran: Alternating Current Circuits; Kurtz and Corcoran: Introduction to Electric Transients.

Prerequisite: EE-251(C).

**EE-665(B) Lines, Filters and Transients** 4-2

This course presents the essential basic principles of transmission lines and filters. The topics covered are: transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and Pi section, constant K and M-derived sections and composite filters. Also included are: DC and AC transients in series, parallel, series-parallel and coupled circuits for particular boundary conditions using the methods of differential equations. Heaviside, Fourier and Laplace methods are included. Non-linear constants are presented. Many problems illustrate the basic theory and the methods of analysis.

Text: Gardner and Barnes: Transients in Linear Systems; Kurtz and Corcoran: Introduction to Electric Transients; Ware and Reed: Communication Circuits.

Prerequisite: EE-241(C), Ma-114(A) or equivalent.

**EE-671(A) Transients** 3-4

This course presents in a very thorough way the basic theory of electrical transients in networks for the curricula requiring preparation for further advanced study. The topics covered are DC and AC transients in series, parallel, series-parallel and coupled circuits for particular boundary conditions using the methods of differential equations, Heaviside, Fourier, and Laplace. Non-linear circuits and forcing functions other than DC and AC are included. Many problems illustrate the basic theory and the methods of analysis.

Text: Gardner and Barnes: Transients in Linear Systems; Kurtz and Corcoran: Introduction to Electric Transients.

Prerequisite: EE-251(C) or EE-272(C).

**EE-672(A) Servomechanisms** 3-3

This course presents a thorough treatment of the basic theory of servomechanisms for curricula requiring further advanced study. In this course the topics covered are elementary forms of control systems, servo system follow-up links, analysis of servomechanisms with viscous damping, error rate damping, integral control, transfer function and db-log frequency analysis methods, error rate stabilization networks, typical design calculations and general considerations. Problems and laboratory work illustrate the theory and the methods of analysis.

Text: Brown and Campbell: Principles of Servomechanisms.

Prerequisite: EE-671(A), EE-452(C) or EE-473(B).

**EE-711(C) Electronics** 3-2

This course treats of the fundamental theory of the electron, gaseous conduction, thermionic emission, and electron tube characteristics. The principles of the amplifier, rectifier, and oscillator circuits are presented in their essentials. Some consideration is given to the special tubes encountered in electronic devices. Laboratory work serves to integrate the principles presented in the classroom with practical applications and circuits.

Text: Fink: Engineering Electronics.

Prerequisite: EE-251(C).

**EE-731(C) Power Electronics** 3-2

This course presents the theory of electronics and synchro instruments and a study of their applications to naval devices. The theory and applications of the various types of electron tubes is covered. Emphasis is placed upon the thyratron tube. Also, the theory of the selsyn instrument and its use are included. The laboratory work consists of experiments that demonstrate the characteristics and applications of tubes and selsyns. Remote control is illustrated with laboratory models.

Text: Ryder: Electronic Engineering Principles.

Prerequisite: EE-231(C).

**EE-745(A) Electronic Control and Measurement** 3-3

This course presents the principles and practice of electronic control and measurement as used in research laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits, with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, speed, pressure and temperature.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: EE-751(C).

**EE-751(C) Electronics** 3-4

This course treats of electron tube characterisctics and the basic circuits in which tubes are used. The theory and application of vacuum tubes and gas tubes are covered, including such special tubes as the ignitron, cathode ray tube and phototube. The basic theory of rectifier and amplifier circuits is developed and illustrated in actual commercial applications. Problems and laboratory work are designed to supplement the classroom presentation.

Text: Ryder: Electronic Engineering Principles.

Prerequisite: EE-451(C).

**EE-753(C) Electronics** 1-2

This course presents an analysis of electronic control circuits. The use of vacuum and gas-filled tubes in the control of motors, generators and mechanical devices is well covered. Laboratory work supplements the theory.

Text: None.

Prerequisite: EE-451(C), EE-751(C).

**EE-755(A) Electronic Control and Measurement** 3-4

This course presents the principles and practice of electronic control and measurement as used in research laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltmeters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits, with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, speed, pressure and temperature.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: EE-751(C).

**EE-771(B) Electronics** 3-2

This course consists of a thorough presentation of the theory of electron tubes and circuits in which they are used for those curricula requiring preparation for further advanced work. It includes the theory of electron motion in electric or magnetic fields, vacuum and gas tube characteristics and the principles of special tubes such as the ignitron, glow tube, cathode ray tube and phototube. Circuit theory of rectifiers, detectors, amplifiers and oscillators is covered, with particular attention to industrial power and control applications. Laboratory experiments and problems supplement the basic theory.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: EE-272(C).

**EE-772(B) Electronics** 3-2

This course is a continuation of EE-771(B). It presents in detail the more complicated electronic circuits encountered in practice with particular attention to the integration of various components in accordance with basic theory of stabilization and feedback.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: EE-771(B).

**EE-871(A) Electrical Machine Design** 4-0

This course presents a thorough quantitative analysis of machine characteristics using the design approach. It serves to develop an appreciation for the limitations and possibilities in electrical machine construction especially for naval applications, and the ability to evaluate properly the merits of present designs. In particular, this course consist of the quantitative study and design of a transformer to meet certain specifications. Later, the analysis of the DC machine is begun.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-472(C).

**EE-872(A) Electrical Machine Design** 4-0

This course is a continuation of EE-871(A). It consists of the completion of the quantitative analysis and design of a DC machine and the beginning of a similar analysis of the synchronous machine.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-871(A).

**EE-873(A) Electrical Machine Design** 4-0

This course is a continuation of EE-872(A). It consists of the completion of the quantitative analsis and design of a synchronous machine and a similar analysis and design of the induction machine.

Text: Slichter: Principles Underlying the Design of Electrical Machinery.

Prerequisite: EE-872(A).

**EE-874(A) Electrical Machine Design** 4-0

This course is a continuation of EE-873(A). The design of the induction machine is completed. Then the machine is analyzed quantitatively and its operating characteristics, both as a motor and as an induction generator are determined.

**Text:** Slichter: Principles Underlying the Design of Electrical Machinery.

**Prerequisite:** EE-873(A).

**EE-971(A) Seminar** 1-0

In the seminar sessions, papers on research and developments in the field of electrical science are presented to the more advanced groups of students. Some appreciation for research methods is developed. In these sessions papers treating of research in progress and matters of major importance in electrical engineering are delivered by the faculty and by the students pursuing an advanced engineering curriculum.

**Text:** None.

**Prerequisite:** A background of advanced work in electrical engineering.

**EE-972(A) Thesis** 0-0

This work provides an opportunity for research and study necessary for the preparation of the thesis as required for the Master's degree in Electrical Engineering. Individual laboratory and library work is performed under the general supervision of the members of the Electrical Engineering Staff.

**Text:** None.

**Prerequisite:** The first two years of the advanced Electrical Engineering curriculum.

# ENGINEERING ELECTRONICS

Es Courses



**Es-036(C) Electronics Administration** 2-0

A problem and lecture series designed to acquaint the student with the administration and organization of electronics activities and applications, ashore and afloat. The principal topics are: Army, Navy and Air Force organization; shipyard electronics organization; radio station administration; electronics supply matters.

Text: None.

Prerequisite: None.

**Es-111(C) DC Electricity** 4-4

This course covers electrical fundamentals and direct current circuits. The principal topics are: circuit fundamentals; batteries; non-linear elements; circuit analysis; magnetic field, inductance; electric field, capacitance; elementary transients.

The factual content of Es-111(C) and Es-112(C) is presented rapidly and constitutes a review for most students. Emphasis is placed on sound basic concepts and analysis techniques. The laboratory work familiarizes the student with electronic components and basic measuring equipment.

Text: Hessler and Carey: Fundamentals of Electrical Engineering.

Prerequisite: Mathematics through the calculus.

**Es-112(C) AC Electricity** 4-3

A continuation of Es-111(C). The principal topics are: fundamental AC concepts; AC circuit analysis; polyphase circuits (brief); non-sinusoidal waves, elementary AC transients.

Text: Reed: Alternating-Current Circuit Theory.

Prerequisite: Es-111(C).

**Es-113(C) Circuit Analysis and Measurements** 3-3

This course covers ordinary measurements techniques and continues into AC circuit theory. The principal topics are: coupled circuits; network theorems; the infinite line; radio frequency bridges; measurements at high frequencies; measurements involving complex wave forms.

Text: Everitt: Communication Engineering; Terman: Radio Engineering; Terman: Measurements in Radio Engineering.

Prerequisite: Es-112(C).

**Es-114(C) Circuit Analysis and Measurements** 3-3

A continuation of Es-113(C). The principal topics are: reflections in lines; solution of the general line; stubs; derivation and use of circle diagrams; constant-K and M-derived filters; impedance measurements with slotted lines.

Text: Everitt: Communication Engineering.

Prerequisite: Es-113(C).

**Es-121(A) Advanced Circuit Theory** 3-2

An introduction to transient phenomena in electrical networks and their solutions on the loop and nodal basis; modes. Solutions are by classical methods, Fourier Integral, Laplace transforms.

Text: Guillemin: Communication Networks, Vol. I; Goldman: Frequency Analysis, Modulation, and Noise; Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Es-114(C).

**Es-122(A) Advanced Circuit Theory** 3-2

A continuation of Es-121(A). The Laplace transform is employed for solution of transients in typical circuits used in radio and radar.

Text: Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Es-121(A).

**Es-123(A) Advanced Circuit Theory** 3-0

A continuation of Es-122(A). The transmission line as a communication facility leading to filter theory is treated. The principal topics are: four terminal networks; Foster's reactance theorem with Cauer's extension; Lagrange's equations; driving point impedance; principle of duality; lumped loaded lines; lattice structures.

Text: Guillemin: Communication Networks, Vol. II.

Prerequisite: Es-122(A).

**Es-126(C) Radio-Frequency Measurements** 2-6

This course covers impedance and frequency bridges and the techniques of the measurement of voltage, current, power, and impedance in the various frequency ranges. The topics include a detailed study of radio-frequency resonant methods, precision slotted lines, microwave measurements, standards of E, R, L, C and F.

Text: Hartshorn: Radio-Frequency Measurements.

Prerequisite: Es-114(C), Es-225(A).

**Es-134(A) Advanced Circuit Theory** 3-0

A continuation of Es-123(A). The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Text: Guillemin: Communication Networks, Vol. II; Bode: Network Analysis and Feedback Amplifiers.

Prerequisite: Es-123(A).

**Es-186(C) Communications Fundamentals** 4-4

This course covers the fundamental principles of radio communications and basic circuits. The principal topics are: fundmentals of energy transmission by means of radio waves; basic alternating-current theory; frequency selectivity circuits; coupled circuits.

Text: Sheingold: Fundamentals of Radio Communications.

Prerequisite: None.

**Es-211(C) Electron Tubes and Circuits** 2-3

This course gives an elementary treatment of thermionic emission, space charge, diodes, triodes, tetrodes, pentodes, cathode-ray tubes, oscilloscopes, gas tubes, thyratrons, and RC-coupled voltage amplifiers.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes; Seely: Electron-tube Circuits; Terman: Radio Engineering.

Prerequisite: None.

**Es-212(C) Electron Tubes and Circuits** 2-3

A continuation of Es-211(C). This course emphasizes the use of the vacuum tube as a switch. The principal topics are: timing, sweep and pulse circuits; such as square-wave generators, clippers, clampers, differentiators, integrators, switching, keying, trigger circuits and multivibrators; rectifiers, power filters and regulated power supplies.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes; Seely: Electron-tube Circuits; Terman: Radio Engineering.

Prerequisite: Es-211(C).

**Es-213(C) Electron Tubes and Circuits** 4-3

A continuation of Es-212(C). This course covers audio and tuned r-f power amplifiers, video and transformer-coupled voltage amplifiers, phase inverters, cathode followers, inverse feedback, r-f, i-f and wide-band tuned amplifiers.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes; Terman: Radio Engineering; Seely: Electron-tube Circuits.

Prerequisite: Es-212(C).

**Es-214(C) Electron Tubes and Circuits** 4-3

A continuation of Es-213(C). The principal topics are: sine-wave oscillators; methods of modulation; methods of detection; avc; discriminators; receiver principles.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes; Seely: Electron-tube Circuits; Terman: Radio Engineering.

Prerequisite: Es-213(C).

**Es-225(A) Electron Tubes** 3-6

A continuation of Es-214(C). The principal topics are: noise; electron ballistics; electron optics; cathode-ray tubes; photo-multiplier tubes; television tubes; polyphase and controlled rectifiers; transistors. Laboratory work includes individual student projects.

Text: Spangenberg: Vacuum Tubes.

Prerequisite: Es-214(C).

**Es-226(A) Ultra-High Frequency Tubes** 4-3

The principal topics are: ultra-high frequency effects in conventional tubes; cavity resonators; klystron and magnetron tubes and circuits; traveling-wave tubes; pulsing circuits; and related laboratory work.

Text: Spangenberg: Vacuum Tubes; Ridenour: Radar System Engineering; Massachusetts Institute of Technology Staff: Principles of Radar, Second Ed.; Bell Lab Journals.

Prerequisite: Es-225(A), Es-623(A).

**Es-227(C) Ultra-High Frequency Tubes** 3-2

This course covers the principles and underlying problems of ultra-high frequency tubes. The principal topics are: limitations of conventional tubes at ultra-high frequency; transit-time effects; electron ballistics; cavity resonators; klystrons; magnetrons; travelling-wave tubes. The course emphasizes a descriptive presentation rather than a mathematical one.

Text: Spangenberg: Vacuum Tubes.

Prerequisite: Es-214(C).

**Es-256(C) Introduction to Radar Aplications of Vacuum Tubes** 2-0

The principal topics are: the use of a tube as a switch; clipping devices; multivibrators; sawtooth generators; simple R-C transient circuits.

Text: Navships 900,016: Radar Electronic Fundamentals.

Prerequisite: None.

**Es-261(C) Electron Tubes and Circuits** 3-2

The first term of a two-term course in the fundamentals and general applications of electron tubes and circuits, primarily for non-communication students. The principal topics are: emission; characteristics of vacuum and gas tubes; rectifiers and filters; grid-controlled rectifiers; class A amplifiers.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: Es-111(C), Es-112(C).

**Es-262(C) Electron Tubes and Circuits** 3-2

A continuation of Es-261(C). The principal topics are: feedback amplifiers; class B and C amplifiers; oscillators; modulation; detection.

Text: Massachusetts Institute of Technology Staff: Applied Electronics.

Prerequisite: Es-261(C).

**Es-271(C) Electronics I** 3-3

An introduction to DC and AC circuit theory. The principal topics are: series and parallel circuit analysis; an introduction to thermionic vaccum tubes.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes.

Prerequisite: None.

**Es-272(C) Electronics II** 3-2

The study of thermionic vacuum tube circuits; simple rectifiers; voltage and power amplifiers; counting circuits; timing circuits; simple R, L and C transients.

Text: Cruft Electronics Staff: Electronic Circuits and Tubes.

Prerequisite: Es-271(C) or equivalent.

**Es-281(C) Electronic Fundamentals** 2-2

This course covers the basic principles of electronics. The principal topics are: a review of basic mathematical concepts; the underlying physical principles of electron-tube operation; characteristics of electron-tube operation.

Text: Robeson: Physics; Eastman: Fundamentals of Vacuum Tubes; Cooke: Mathematics for Electricians and Radiomen; Sheingold: Fundamentals of Radio Communications.

Prerequisite: None.

**Es-282(C) Vacuum Tube Circuits** 4-4

A continuation of Es-281(C). The course covers the operational characteristics of electron tubes and some of their applications. The principal topics are: general operational features of diodes, triodes, multigrid tubes and gas tubes; amplification of small alternating voltages; power amplifiers.

Text: Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-281(C).

**Es-283(C) Vacuum Tube Circuits** 4-3

A continuation of Es-282(C). The course covers further applications of electron tubes, in continuation of the material presented in Es-282(C). The principal topics are: sine-wave oscillators; amplitude modulation and the A-M transmitter; demodulation and the TRF receiver; frequency conversion and the superheterodyne A-M receiver; power supplies; frequency modulation.

Text: Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-282(C).

**Es-286(C) Pulsing and High-Frequency Circuits** 3-2

This course covers the principles and underlying problems of pulsing and high-frequency circuit operation. The principal topics are: characteristics of nonsinuoidal waves; pulse-shaping techniques; the sawtooth generator, multivibrator, and blocking oscillator; problems and techniques of high-frequency circuit operation; the magnetron and velocity-modulated tubes; guided waves.

Text: Navships 900,016: Radar Electronic Fundamentals; Massachusetts Institute of Technology Staff: Principles of Radar, Second Ed.; Sheingold: Fundamentals of Radio Communications.

Prerequisite: Es-282(C).

**Es-321(B) Radio Systems** 3-3

This course is the first of a sequence of five on the engineering applications of theoretical electronics to the specific problems of radio communications and electronic systems aimed to give the student experience in design and to integrate his previous theoretical training as applied in radio systems engineering. Included is a general survey of the basic problems of a communications system with emphasis on the design of transmitters for medium and high frequencies.

Text: Terman: Radio Engineer's Handbook; War Department Technical Manual, TM11-486 (Electrical Communication System Engineering); Navy equipment instruction books.

Prerequisite: Es-225(A), Ma-104(A).

**Es-322(B) Radio Systems** 3-3

This is a continuation of the series begun in Es-321(B). Emphasis is placed upon the design of receivers for the reception of amplitude-modulated signals in the medium and high frequency bands. The design problem is extended to include the VHF region and the changes introduced by the use of frequency and phase modulation.

Text: Sturley: Radio Receiver Design; Terman: Radio Engineer's Handbook; Massachusetts Institute of Technology Radiation Laboratory Series: Microwave Receivers; other selected references.

Prerequisite: Es-321(B).

**Es-326(B) Radio Systems** 3-3

This course is the first of a sequence of five on the engineering applications of theoretical electronics to the specific problems of radio communications and electronics systems, aimed to give the student an appreciation of the problems encountered in such systems' design and to integrate his previous theoretical training as applied in radio systems engineering. Included is a general survey of the basic problems of a communications system with emphasis on typical designs employed in transmitters for medium and high frequencies.

Text: Terman: Radio Engineer's Handbook; War Department Technical Manual, TM 11-486 (Electrical Communication System Engineering); Navy equipment instruction books.

Prerequisite: Es-114(C), Es-214(C).

**Es-327(B) Radio Systems** 4-3

This is a continuation of the series begun in Es-326(B). Emphasis is placed upon typical circuit

designs of receivers for the reception of amplitude-modulated signals in the medium and high frequency band. Circuit modifications to include the VHF region and the changes introduced by the use of frequency and phase modulation are also covered.

Text: Sturley: Radio Receiver Design; Terman: Radio Engineer's Handbook; Massachusetts Institute of Technology Radiation Laboratory Series: Microwave Receivers; other selected references.

Prerequisite: Es-326(B).

**Es-328(B) Radio Systems** 2-3

This course continues the systems series. The principal topics are: the application of teletype and frequency-shift keying to radio transmission; tone multiplex; applications of multiplexing to remote control; single side-band transmission theory and basic single side-band multiplex transmitter and receiver design.

Text: Naval instruction books; instructor's notes.

Prerequisite: Es-327(B).

**Es-333(B) Radio Systems** 2-3

This course continues the systems series. The principal topics are: the application of teletype and frequency-shift keying to radio transmission; tone multiplex; applications of multiplexing to remote control; single side-band transmission theory and basic single side-band multiplex transmitter and receiver design.

Text: Naval instruction books; instructor's notes.

Prerequisite: Es-322(B).

**Es-386(C) Transmitter and Receivers** 3-3

This course covers the operational characteristics of typical Navy-type transmitters and receivers. Included topics are frequency standards and meters; Navy transmitters; Navy receivers.

Text: Lecture notes; equipment instruction books.

Prerequisite: Es-283(C), Es-786(C).

**Es-421(B) Radar Fundamentals** 2-3

This course covers the principles and underlying problems of pulse techniques. Principal topics are: pulse-shaping, switching, clipping, differentiating and integrating circuits; sweep-circuit generators; CRT characteristics, such as phosphors and electron optics.

Text: Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-114(C).

**Es-422(B) Radar System Engineering** 3-3

A study of the fundamental principles of radar. The principal topics are: the theory of operation of radar timing circuits, indicators, modulators, transmitters, r-f systems and receivers, the radar range equation.

Text: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-421(B).

**Es-423(B) Radar System Engineering** 3-6

A continuation of Es-422(B). The course contents include a study of representative search, fire-control and IFF systems, including airborne, with particular attention to design features; a study of current radar developments; related laboratory work on current Navy radar equipment.

Text: Ridenour: Radar System Engineering.

Prerequisite: Es-422(B).

**Es-431(B) Radar System Engineering** 3-3

A treatment of the fundamental principles of radar. The principal topics are: the theory of operation and design features of radar timing circuits, indicators, modulators, transmitters, r-f systems and receivers.

Text: Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

Prerequisite: Es-226(A).

**Es-432(B) Radar System Engineering** 3-6

A continuation of Es-431(B). The course contents include a study of representative search, fire-control and IFF systems, including airborne, with particular attention to design features; a study of current radar developments; related laboratory work on current Navy radar equipment.

Text: Ridenour: Radar System Engineering.

Prerequisite: Es-431(B).

**Es-446(C) Introduction to Radar** 2-2

The course contents include a study of the radar range equation, i.e., effect of pulse duration, pulse repetition frequency, types of targets, etc.; block diagram studies of current fire-control systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques; and laboratory work that emphasizes operational techniques of current fire-control systems.

**Text:** Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

**Prerequisite:** None.

**Es-447(C) Electronics Pulse Techinques** 3-0

This course presents the basic principles of pulse-shaping circuits, clippers, peakers, gaters, etc.; pulse-forming networks and artificial lines. Also, r-f, i-f and video amplifiers are treated from the view point of pulse amplification, distortion tolerances and requirements. The course is directed toward preparing the students for more advanced courses in radar.

**Text:** Ridenour: Radar System Engineering; Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

**Prerequisite:** None.

**Es-456(C) Introduction to Radar (Airborne)** 2-2

The course contents include a study of the radar range equation, i.e., effect of pulse duration, pulse repetition frequency, types of targets, etc., block diagram studies of current airborne systems with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques and laboratory work on current airborne radar equipment.

**Text:** Massachusetts Institute of Technology Radar School Staff: Principles of Radar, Second Ed.

**Prerequisite:** None.

**Es-521(B) Special Systems** 3-3

A continuation of the series starting with Es-321(B). The principal topics are: pulse-modulation principles; pulse-time-modulation multiplex; principles of television; television receiver and transmitter design practice; facsimile; and basic telemetering systems.

**Text:** Naval instruction books; instructor's notes.

**Prerequisite:** Es-327(B).

**Es-522(B) Special Systems** 3-3

A continuation of the special systems series. The principal topics are: principles of radio direction finding and navigation, and radio and radar countermeasures.

**Text:** Massachusetts Institute of Technology Radiation Laboratory Series: Loran; Radio Research Laboratory Staff: Very High Frequency Techniques, Vol. I; other selected references.

**Prerequisite:** Es-521(B).

**Es-531(B) Special Systems** 3-3

A continuation of the series starting with Es-321(B). The principal topics are: pulse-modulation principles; pulse-time-modulation multiplex; principles of television; television receiver and transmitter design; facsimile and basic telemetering systems.

**Text:** Naval instruction books; instructor's notes.

**Prerequisite:** Es-333(B).

**Es-532(B) Special Systems** 3-3

A continuation of the special systems series. The principal topics are: principles of radio direction finding and navigation, and radio and radar countermeasures.

**Text:** Massachusetts Institute of Technology Radiation Laboratory Series: Loran; Radio Research Laboratory Staff: Very High Frequency Techniques, Vol. I; other selected references.

**Prerequisite:** Es-531(B).

**Es-536(B) Counter Measures** 2-3

The principal topics are: principles of radio direction finding; special electronic circuits with particular application to the field of electronic countermeasures; basic principles of electronic countermeasures tactics and operational procedures; passive and active electronic countermeasures equipment.

**Text:** Radio Research Laboratory Staff: Very High Frequency Techniques, Vols. I and II; Navy equipment manuals; instructor's notes.

**Prerequisite:** None.

**Es-586(C) Special Systems** 3-3

Course contents cover Navy electronic systems other than communications transmitters and receivers. The principal topics are: loran systems; radar systems; image transmission systems; frequency-shift keying techniques; multiplex systems.

**Text:** Lecture notes; equipment instruction books; Sheingold: Fundamentals of Radio Communications.

**Prerequisite:** Es-283(C), Es-786(C).

**Es-621(A) Electromagnetics** 3-0

An introduction to the fundamental definitions and circuit parameters later to be used in resonant cavities, wave guides, wave propagation, etc., as exemplified through the differential equations solution of lumped circuits and transmission lines. An application of vector analysis to electrostatics and magnetostatics in rectangular and in generalized

coordinates, including the gradient, divergence and curl of electromagnetic fields; scalar and vector potentials; energy stored in electric and in magnetic fields. Text material is considerably amplified in class lectures.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Ma-124.

**Es-622(A) Electromagnetics** 4-0

A continuation of Es-621(A). An application of complex variables to potential theory; derivation of capacitance and inductance per unit length for open wire and coaxial transmission lines; application of Bessel equations to potential theory; Maxwell's equations; relations between units; Poisson's equations; retarded vector potentials; radiation from current dipole, halfwave antennas, radiation resistance of halfwave antennas in terms of Ci and Si functions; antenna arrays; field patterns and gain of yagi arrays; input impedance of yagi arrays.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-621(A).

**Es-623(A) Electromagnetics** 4-0

A continuation of Es-622(A). The principal topics are: skin effect and internal impedance; solutions involving Bessel and Hankel functions; calculation of inductance; propagation and reflection of plane electromagnetic waves; attenuation; power factor; waves guided by lossy planes; solutions of Maxwell's equations for rectangular and cylinderical wave guides.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-622(A).

**Es-624(A) Electromagnetics** 3-0

A continuation of Es-623(A). The principal topics are: radial disk transmission lines; resonant cavities; generalized Maxwell's equations; generalized method of deriving radiation field patterns; radiation resistance; long straight wire antenna; Vee antenna; radiation from end of wave guide; rhombic antenna; non-uniform transmission line; input impedance of antennas.

Text: Chaney: Electromagnetics in Engineering Electronics.

References: Ramo and Whinnery: Fields and Waves in Modern Radio; Schelkunoff: Electromagnetic Waves.

Prerequisite: Es-623(A).

**Es-721(B) Antennas and Wave Propagation** 3-3

This course is designed to give the student the best possible understanding of the problems involved in the radiation and propagation of electromagnetic energy without the use of the classic Maxwell equation type of approach. The emphasis is on practical problems encountered in communications engineering, including selection of proper antennas for various services as well as proper frequencies for optimum transmission.

Text: Instructor's notes; Kraus: Antennas; King, Mimno, and Wing: Antennas, Transmission Lines, and Wave Guides.

Prerequisite: Es-327(B), Es-114(C).

**Es-722(B) Antennas and Wave Propagation** 3-3

A continuation of Es-721(B).

Text: Instructor's notes; Kraus: Antennas; King, Mimno, and Wing: Antennas, Transmission Lines, and Wave Guides.

Prerequisite: Es-721(B).

**Es-736(B) Antennas, Transmission Lines** 3-3

This course presents the engineering problems associated with the practical design of antennas, antenna systems, and transmission lines. A technique of rapid approximation of antenna field patterns is presented. All common receiving and transmitting antennas are presented and analyzed. The problems inherent in the various frequency ranges are discussed, including the microwave region. The problem of efficient transmission of r-f energy, matching, phasing and achieving proper current distributions are studied. The classwork is accompanied by considerable problem drill and measurements on typical systems.

Text: None.

Prerequisite: Es-624(A).

**Es-786(C) R-F Energy Transmission** 3-2

This course covers the principles and techniques of energy transmission by means of radio-frequency waves. The principal topics are: conditions for maximum energy transfer between circuits; r-f transmission lines for energy transfer; lines as circuit elements; principles of energy radiation; directional-radiation techniques; propagation characteristics. The laboratory periods are occasionally used for lecture-demonstrations.

**Text:** Terman: Radio Engineering; NavShips 900,016: Radar Electronic Fundamentals; Sheingold: Fundamentals of Radio Communications.

**Prerequisite:** Es-186(C).

**Es-831(A) Thesis** 2-0

This course provides the student with the opportunity for study and research in connection with the preparation of the thesis as required in the electronics curricula. Few formal classes are scheduled. Instead, the student is concerned with the choice of a suitable topic and does the necessary preliminary library and laboratory work. Staff members are consulted as the work progresses.

**Text:** None.

**Prerequisite:** None.

**Es-832(A) Thesis** 4-0

This course continues and completes the preparation of the thesis begun in Es-831(A).

**Text:** None.

**Prerequisite:** None.

**Es-836(A) Project Seminar** 1-0

This course provides the student with the opportunity to prepare a report on the project in which he was engaged during his experience at an industrial laboratory. The student is required to give an oral seminar report.

**Text:** None.

**Prerequisite:** None.

**Es-991(C) and 992(C) Introduction to Electronics** 2-0

This course will continue through two consecutive terms and is intended to acquaint the student officer with the general principles, capabilities and limitations of radio, sonar and radar and to give him a limited familiarity with equipment. The following topics will be studied in an elementary manner: resonant circuits; principles of vacuum tubes; their actions as oscillators, amplifiers, detectors, modulators; general principles of transmitters and receivers, both AM and FM; antennas, wave propagation; basic principles of radar and sonar.

**Text:** None.

**Prerequisite:** None.

# GEOLOGY

Ge Courses



**Ge-101(C) Physical Geology** 3-0

This course initiates the student into the study of the various geological phenomena. Among the principal topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weather ring and erosion; stream sculpture; glaciation; surface and sub-surface waters; volcanism, dynamic processes; structural geology; and interpretation of topographic maps. Frequent reference is made to other than the prescribed textbook. The course is given as much as possible to stress those topics of particular interest to the petroleum engineer.

Text: Longwell, Flint, Knopf: Physical Geology.

Prerequisite: None.

**Ge-241(C) Geology of Petroleum** 2-2

This course includes discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurrence and distribution. The important oil fields of the world are then taken up in detail as to the occurrence and associated structures in particular fields. The following regions are studied: Eastern United States, Mid-Continent, Gulf Coast, Rocky Mountains, Pacific Coast, North America (except U. S.), West Indies, South America, Europe, Russia, oceans and Asia. This course is supplemented by reading assignments in the current petroleum and petroleum geology journals.

Text: Lalicker: Principles of Petroleum Geology.

Prerequisite: Ge-101(C).

**Ge-302(C) Determinative Mineralogy** 1-4

The lectures are designed to familiarize the student with the principles and techniques involved in determining minerals in the laboratory. The laboratory periods are spent in the determination of some fifty of the more common minerals by blowpipe, chemical, x-ray diffraction and crystallographic methods. The student is also made familar with the methods employed in the use of chemical microscopy for the determination of certain elements.

Text: Lewis, Hawkins: Determinative Mineralogy; Dana, Ford: Textbook of Mineralogy.

Prerequisite: Cr-301(B) or Cr-311(B).

**Ge-401(C) Petrology and Petrography** 2-3

This course consists of a series of lectures on the differentiation of magmas into the various igneous rock series on the basis of physical chemical theories; the characteristics, structures and textures of igneous rocks; the metamorphic rocks, mineral alteration, metamorphism and the resultant rock types. The laboratory work consists of the study of the various rocks in hand specimens, and in thin selections under the petrographic miroscope. When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the field.

Text: Pirsson, Knopf: Rocks and Rock Minerals.

Prerequisite: Ge-101(C), Cr-301(B) or Cr-311.

# INDUSTRIAL ENGINEERING

IE Lecture Courses



**IE-101(C) Principles of Industrial Organization** 0-1

A study of the origin and growth of industrial enterprises, principles of organization, control and production, systems research, standards and standardization, industrial relations, and the effects of science upon industry. This course is presented in a series of lectures delivered by authorities in the field of management engineering.

Text: None.

**Prerequisite:** None.

**IE-103(C) Applied Industrial Organization** 0-1

A study of the application of the principles of industrial organization to the structure of actual industrial and government enterprises. In a series of lectures, given by representatives of major industries and naval activities, an over-all picture of the structure of major organizations in presented. Examples of successful organizations are described by the visiting speakers, also problems relating to industry as a whole are discussed.

Text: None.

**Prerequisite:** None.

**IE-104(C) Human Engineering** 0-1

A study of progress in research in psychophysical systems; quantitative methods and tests used in research into complex instrument systems; optimum physical conditions for operation of instruments; problems of equipment design; design of tasks; working environment; appraisal of systems.

Text: None.

**Prerequisite:** None.

Reference: Chapanis, Garner, Morgan and Sanford: Men and Machines; Chapanis, Garner and Morgan: Applied Experimental Psychology; National Research Council: Human Factors in Undersea Warfare.

# MARINE ENGINEERING

NE Courses



**NE-101(C) Main Propulsion** 3-0

A practical study of naval geared-turbine main propulsion plants, boilers and main propulsion plant auxiliaries. This course deals primarily with the Bureau of Ships Manual, supplemented by Bureau of Ships Journals and letters, and by descriptive texts as necessary. The purpose of the course is to give the technical engineer a sound basic knowledge of, and familiarity with, the procedures set forth by the Bureau of Ships with regard to the operation, maintenance and repair of main propulsion machinery.

Text: Bureau of Ships Manual; Bureau of Ships Journals; Naval Turbines—1949; Naval Boilers—1949.

**Prerequisite:** None.

**NE-102(C) Auxiliary Machinery** 3-0

A practical study of naval machinery other than main propulsion machinery, boilers and main propulsion plant auxiliaries. This course deals primarily with the Bureau of Ships Manual supplemented by Bureau of Ships Journals and letters and by descriptive texts as necessary. The purpose of the course is to give the techincal engineer a sound basic knowledge of, and familiarity with, the procedures set forth by the Bureau of Ships with regard to the operation, maintenance and repair of subject machinery.

Text: Bureau of Ships Manual; Bureau of Ships Journals; Naval Auxiliary Machinery—1949.

**Prerequisite:** None.

**NE-103(C) Engineering Department Administration** 2-0

A study of the administrative duties of the Engineer Officer afloat. Subjects treated include: engineering department organization, routine tests and inspections, machinery index, machinery history, current ship's maintenance project, ship's force overhauls, tender overhauls, shipyard overhauls, supplies, spare parts, requisitions, engineering casualty control, safety precautions, engineering competition and economical operation of engineering plants.

Text: Bureau of Ships Manual; Bureau of Ships Journals; fleet training publications; prepared pamphlets on above subjects.

**Prerequisite:** None.

# MATHEMATICS

Ma Courses



**Ma-100(C) Vector Algebra and Geometry** 2-0

Coordinates and related concepts in three dimensions. Vectors and their addition. Lines and planes in scalar and vector notation. Determinants and linear systems. Products of vectors, and their applications. Special surfaces.

**Text:** Smith, Gale and Neelley: New Analytic Geometry; Weatherburn: Elementary Vector Analysis.

**Prerequisite:** A former course in plane analytic geometry.

**Ma-101(C) Introduction to Engineering Mathematics** 3-0

Introduction to infinite series, differential equations, hyperbolic functions. Partial derivatives, multiple integration.

**Text:** Sokolnikoff and Sokolnikoff: Higher Mathematics; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised edition); Eshbach: Handbook of Engineering Fundamentals.

**Prerequisite:** A special review course in differential and integral caculus, or equivalent, and Ma-100 (C) to be taken concurrently.

**Ma-102(C) Differential Equations and Series** 5-0

A continuation of Ma-100(C) and Ma-101(C). Elementary operations with complex quantities. Solution of algebraic equations, Graeffe's method. Further study of ordinary differential equations and their applications, stability criteria, systems of linear differential equations with constant coefficients. Operations on series, power series. Introduction to elliptic integrals, Fourier series, numerical harmonic analysis.

Text: Cohen: Differential Equations (Revised); Sokolnikoff and Sokolnikoff: Higher Mathematics; Eshbach: Handbook of Engineering Fundamentals.

Prerequisite: Ma-100(C), Ma-101(C).

**Ma-103(B) Functions of Several Variables and Vector Analysis** 5-0

A continuation of Ma-102(C). Elementary matrix theory and applications. Analytic geometry of space curves and surfaces. Applications of partial derivatives. Differentiation of vectors. Differential operators. Line, surface, and space integrals with applications. Divergence theorem and the theorems of Green and Stokes. Curvilinear coordinates. Introduction to analytic functions of a complex variable.

Text: Sokolnikoff and Sokolnikoff: Higher Mathematics; Weatherburn: Elementary and Advanced Vector Analysis; Smith, Gale and Neelley: New Analytic Geometry; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Ma-102(C) or Ma-132(C).

**Ma-104(A) Partial Differential Equations and Related Topics** 5-0

A continuation of Ma-103(B). Total differential equations and systems of ordinary differential equations. Linear and other first order partial differential equations. Special cases of higher order partial differential equations with special emphasis on those with constant coefficients. Solution of ordinary differential equations in series. Gamma, Beta, Bessel and Legendre functions. Introduction to boundary value problems and orthogonal functions with applications to heat flow, vibrations of strings and membranes and flow of electricity in cables. Interpolation formulas of Newton, Stirling and Lagrange. Quadrature formulas and numerical integration of ordinary differential equations and systems of such equations.

Text: Sokolnikoff and Sokolnikoff: Higher Mathematics; Cohen: Differential Equations (Revised); Scarborough: Numerical Mathematical Analysis.

Prerequisite: Ma-103(B).

**Ma-105(A) Fourier Series and Boundary Value Problems** 4-0

Derivation of the basic partial differential equations of theoretical physics. Study of the trigonometric, Bessel and Legendre functions, and other systems of orthogonal functions. The Sturm-Liouville theory. Solution of boundary value problems by orthogonal series. Methods of relaxation. Uniqueness of the solution.

Text: Churchill: Fourier Series and Boundary Value Problems; H. W. Emmons: Numerical Solution of partial Differential Equations (Quart. Appl. Math., 2, 1944, 173-195).

Prerequisite: Ma-104(A).

**Ma-106(A) Complex Variable and Laplace Transform** 4-0

Analytic functions; Cauchy's theorem and formula, Taylor and Laurent series, residues, contour integration, conformal mapping. Laplace transform and its use in solving ordinary differential equations; special theorems and manipulations for the Laplace transform; application to partial differential equations and difference equations.

Text: Churchill: Introduction to Complex Variables and Applications; Churchill: Modern Operational Mathematics in Engineering; Gardner and Barnes: Transients in Linear Systems.

Prerequisite: Ma-104(A) or special permission.

**Ma-107(A) Orthogonal Functions and Integral Equations** 3-0

A study of orthogonal functions and of Sturm-Liouville and other eigenvalue problems, illustrated by Fourier series, Bessel functions, and the polynomials of Legendre, Hermite, Jacobi and Laguerre; solution of integral equations by the method of iteration, of Fredholm, and of Hilbert-Schmidt; applications.

Text: Churchill: Fourier Series and Boundary Value Problems; Jackson: Fourier Series and Orthogonal Polynomials; Margenau and Murphy: Mathematics of Physics and Chemistry.

Prerequisite: Permission of instructor.

**Ma-109(A) Topics in Advanced Calculus** 3-0

Extension of natural numbers to real number system; basic theorems on limits; continuity and differentiation properties of functions; the definite integral and improper definite integrals; infinite series.

Text: Courant: Differential and Integral Calculus, Volume I.

Prerequisite: Ma-104(A) or Ma-184(A) or one of these to be taken concurrently.

**Ma-111(C) Introduction to Engineering Mathematics** 3-0

Partial differentiation; multiple integrals; solution of algebraic equations; algebra and complex num-

bers; introduction to infinite series and ordinary differential equations.

Text: Sokolnikoff and Sokolnikoff: Higher Mathematics; Golomb and Shanks: Ordinary Differential Equations; Granville, Smith and Longley: Elements of the Differential and Integral Calculus.

Prerequisite: A special review course in differential and integral calculus, or the equivalent, and Ma-100 to be taken concurrently.

**Ma-112(B) Differential Equations and Boundary Value Problems** 4-0

A continuation of Ma-111(C); systems of ordinary linear differential equations with constant coefficients; the Laplace transforms; series solutions of differential equations; boundary value problems and orthogonal functions including Fourier series.

Text: Hildebrand: Advanced Calculus for Engineers; Golomb and Shanks: Ordinary Differential Equations.

Prerequisite: Ma-111(C).

**Ma-113(B) Vector Analysis and Introduction to Partial Differential Equations.** 3-0

A continuation of Ma-112(B); calculus of vectors with geometric applications; line, surface and volume integrals involving vector fields with applications to fluid flow problems, differentiation under the integral sign and introduction to partial differential equations.

Text: Hildebrand: Advanced Calculus for Engineers; Sokolnikoff and Sokolnikoff: Higher Mathematics.

Prerequisite: Ma-112(B), Ma-100(C).

**Ma-114(A) Partial Differential Equations and Functions of a Complex Variable** 3-0

A continuation of Ma-113(B); solution of the Laplace and Poisson partial differential equations occurring in engineering; functions of a complex variable; analytic functions; line integrals; singularities; residues; evaluation of integrals; conformal mapping and applications.

Text: Hildebrand: Advanced Calculus for Engineers; Churchill: Complex Variable.

Prerequisite: Ma-113(B).

**Ma-116(A) Matrices and Numerical Methods** 4-0

Elementary properties and types of matrices; matrix algebra; calculus of matrices; latent roots and characteristic vectors of matrices; numerical operations with matrices; numerical solution of systems of linear equations and of algebraic equations; numerical methods for solving boundary value problems and ordinary differential equations.

Text: Frazer, Duncan and Collar: Elementary Matrices; reprints of articles from professional journals.

Prerequisite: Ma-154(A).

**Ma-118(A) Mathematics of Stability Analysis** 3-0

This course covers topics important in the study of aircraft flight performance. These topics include differential operator methods, Laplace transform methods, matrix algebra, Lagrange's equations, complex variable theory and non-linear differential equations.

Text: Pipes: Applied Mathematics for Engineers and Physicists.

Prerequisite: Ma-104(A) or Ma-154(A).

**Ma-131(C) Algebraic Equations and Series** 3-0

Solution of algebraic equations, Graeffe's method. Determinants and systems of linear equations. Fundamentals of series. Power series and applications. Fourier Series.

Text: Sokolnikoff and Sokolnikoff: Higher Mathematics; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: A special review course in differential and integral calculus or the equivalent.

**Ma-132(C) Topics in Engineering Mathematics** 5-0

Introduction to three-dimensional analytics and vectors. Partial differentiation and multiple integrals. Ordinary differential equations of first order. Linear differential equations with constant coefficients.

Text: Smith, Gale and Neelley: Analytic Geometry; Sokolnikoff and Sokolnikoff: Higher Mathematics; Weatherburn: Elementary Vector Analysis; Cohen: Differential Equations (Revised).

Prerequisite: A Special review course in differential and integral calculus or the equivalent, and Ma-131 to be taken concurrently.

**Ma-134(B) Vector Mechanics and Introduction to Statistics** 5-0

Vector equations of motion. Streamlines and trajectories. Irrotational, solenoidal and linear vector fields. Elementary differential geometry of surfaces. Fundamentals of probability. Preliminary consider-

ations in the analysis of observational data. Bernoulli and Poisson distributions.

Text: Weatherburn: Advanced Vector Analysis; Snyder and Sisam: Analytic Geometry of Space; Scheffe: Theory of Probability; Wilks: Elementary Statistical Analysis.

Prerequisite: Ma-103(B).

**Ma-135(B) Partial Differential Equation and Numerical Methods** 4-0

Total differential equations and systems of linear differential equations. Partial differential equations. Introduction to orthogonal functions and boundary value problems with applications to physics. Numerical interpolation, differentiation and integration. Elementary alignment charts.

Text: Cohen: Differential Equations (Revised); Churchill: Fourier Series and Boundary Value Problems; Scarborough: Numerical Mathematical Analysis.

Prerequisite: Ma-103(B).

**Ma-140(C) Survey of Calculus** 3-0

Definition of derivatives; rules for differentiation; applications of derivatives; integration as inverse of differentiation; standard integration formulas; definite integrals as limit of sum; applications to area, volume, moment problems; motion problems, curvature, equation solving and other applications.

Text; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Previous study of the calculus.

**Ma-161(C) Algebra, Trigonometry and Analytic Geometry** 5-0

Review of elementary algebraic operations. Exponent laws and logarithms. Variables and functions of variables. Coordinate representation of functions; graphs. The trigonometric functions. The straight line and its slope. Simultaneous linear equations. The quadratic equation. Elemetary equations of the conics.

Text: Brink: A First Year of College Mathematics.

Prerequisite: None.

**Ma-162(C) Introduction to Calculus** 5-0

The limit concept. The derivatives of elementary functions. Elementary applications of derivatives. Differentials, higher order derivatives and curvature. The integral as an antiderivative and as an area. Elementary applications of integration.

Text: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Ma-161(C).

**Ma-163(C) Calculus and Vector Analysis** 5-0

Elementary vector operations. Infinite series. Partial derivatives, total derivatives and total differentials with applications. Partial and multiple integrals. Differentiation of vectors; gradient, divergence and curl. Introduction to line, surface and volume integrals.

Text: Phillips: Vector Analysis; Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition).

Prerequisite: Ma-162(C).

**Ma-171(C) Special Topics in Calculus I** 3-0

Algebra of complex numbers. Introduction to differential equations. Multiple integrals. Hyperbolic functions.

Text: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition); Churchill: Introduction to Complex Variables and Applications; Reddick and Miller: Advanced Mathematics for Engineers.

Prerequisite: A special review course in differentianl and integral calculus, or the equivalent (e.g. Ma-140(C)); and Ma-100(C), which can be taken concurrently.

**Ma-172(C) Special Topics in Calculus II** 3-0

Partial derivatives and applications. Series of constants. Expansion of functions. Series of functions.

Text: Granville, Smith and Longley: Elements of the Differential and Integral Calculus (Revised Edition); Reddick and Miller: Advanced Mathematics for Engineers.

Prerequisite: Ma-171(C).

**Ma-173(B) Special Topics in Calculus III** 3-0

Fourier series. Linear differential equations of higher order and systems of such equations. Introduction to functions of a complex variable.

Text: Reddick and Miller: Advanced Mathematics for Engineers; Churchill: Introduction to Complex Variables and Applications.

Prerequisite: Ma-172(C).

**Ma-174(B) Special Topics in Calculus IV** 3-0

Introduction to Laplace transform. Vector differential calculus.

**Text:** Churchill: Modern Operational Mathematics in Engineering; Reddick and Miller: Advanced Mathematics for Engineers.

**Prerequisite:** Ma-173(B).

**Ma-181(C) Directional Derivatives and Locus Integrals** 3-0

Partial derivatives and their physical applications. Directional derivatives and gradients. Line integrals, surface integrals, volume integrals, and their physical interpretations.

**Text:** Burington and Torrance: Higher Mathematics.

**Prerequisite:** A special review course in differential and integral calculus or the equivalent, and Ma-100 to be taken concurrently.

**Ma-182(C) Differential Equations and Vector Analysis** 5-0

Ordinary first order differential equations. Higher order linear differential equations. Systems of equation. Series. Vector differential operators. Vector integral relations. Physical applications.

**Text:** Cohen: Differential Equations (Revised); Phillips: Vector Analysis; Weatherburn: Elementary and Advanced Vector Analysis.

**Prerequisite:** Ma-100(C) and Ma-181(C).

**Ma-183(B) Complex Variables and the Differential Equations of Theoretical Physics** 5-0

Algebra of complex numbers. Derivatives and integrals of complex variables. Cauchy's Theorem and its applications. Solution of partial differential equations by Fourier series. Orthogonal series.

**Text:** Churchill: Complex Variables; Churchill: Fourier Series and Boundary Value Problems.

**Prerequisite:** Ma-182(C).

**Ma-184(A) Laplace Transforms and Matrices** 3-0

Definition and properties of Laplace transforms. Solution of ordinary and partial differential equations by Laplace transforms. Algebra of matrices. Characteristic values of matrices and differential operators.

**Text:** Churchill: Modern Operationl Mathematics; Margenau and Murphy: Mathematics of Physics and Chemistry.

**Prerequisite:** Ma-183(B).

**Ma-194(A) Laplace Transforms, Matrices and Variations** 5-0

Definition and properties of Laplace transforms. Solution of ordinary and partial differential equations by Laplace transforms. Algebra of matrices. Characteristic values of matrices and differential operators. Introduction to calculus of variations.

**Text:** Churchill: Modern Operational Mathematics; Margenau and Murphy: Mathematics of Physics and Chemistry; Burington and Torrance: Higher Mathematics.

**Prerequisite:** Ma-183(B).

**Ma-201(C) Graphical and Mechanical Computation** 0-2

Construction of scales. Use of coordinate papers. Construction of nomograms, including alignment charts, by geometric methods and use of determinants. Improvement of charts by projection (accomplished by determinants). Theory and use of the planimeter and integrator.

**Text:** Lipka: Graphical and Mechanical Computation; Rybner: Nomograms (G.E. Review, 33, 1930, 164ff); departmental notes.

**Prerequisite:** Ma-100(C). (May be taken concurrently.)

**Ma-251(C) Graphical and Mechanical Computation** 0-4

The theory and practical design of nomograms including: scales; intersection diagrams and alignment diagrams for relations between three variables; combinations of such diagrams for three or more variables; nomographic representation of empirical data. The theory and use of the planimeter, integrator, integraph and harmonic analyzer.

**Text:** Hewes and Seward: Design of Diagrams for Engineering Formulas; J. Rybner: Nomograms (G.E. Review, 33, 1930, 164 ff); Lipka: Graphical and Mechanical Computation; departmental notes.

**Prerequisite:** Ma-100(C). (May be taken concurrently.)

**Ma-301(B) Statistics** 3-2

Fundamental principles of probability. Probability distributions with special emphasis on the binomial, Poisson and normal distributions. Simple and multiple regressions and correlation. Distribution of mean, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses.

Text: Wilks: Elementary Statistical Analysis; Hoel: Introduction to Mathematical Statistics.

Prerequisite: Ma-103(B). (May be taken concurrently.)

**Ma-331(A) Statistics** 4-2

A continuation of Ma-134(B). Gamma and Beta functions. Mathematical expectation, moments and moment generating functions. Theoretical frequency distributions; the normal, Pearson type III and the chi-squared distribution functions. Distribution functions of two or more variables. Large and small sampling theory. Testing statistical hypotheses; sampling and the design of experiments. Applications to problems in aerology.

Text: Kenney: Mathematics of Statistics; Hoel: Introduction to Mathematical Statistics.

Prerequisite: Ma-134(B).

**Ma-361(C) Statistics** 4-2

Frequency distribution for discrete and grouped data. Elements of the theory of probability with applications. The binomial, Poisson, and normal distributions. Elements of sampling theory and statistical inference with applications. Simple correlation.

Text: Wilks: Elementary Statistical Analysis.

Prerequisite: Ma-163(C).

**Ma-381(B) Probability** 4-0

Discrete probability. Theorems of total and compound probability. Binomial probabilities with limiting cases and methods of evaluation. Probabilities of hypotheses and Baye's Theorem. Expectations. Bernouilli's Theorem. Probabilities in continuum and geometrical problems.

Text: Wilks: Elementary Statistical Analysis; Uspensky: Introduction to Mathematical Probability.

Prerequisite: Ma-181(B).

**Ma-382(A) Probability and Statistics** 2-0

Law of large numbers. Central limit theorem. Probability distributions and moment generating functions. Multivariate normal distribution. Sampling distributions.

Text: Uspensky: Introduction to Mathematical Probability; Mood: Introduction to the Theory of Statistics.

Prerequisite: Ma-381(B).

**Ma-383(A) Statistics** 2-3

Point and interval estimation. Tests of hypotheses. Regression and linear hypotheses. Analysis of variance. Sequential analysis. Introduction to modern high-speed electrical computation equipment.

Text: Mood: Introduction to the Theory of Statistics.

Prerequisite: Ma-382(A).

**Ma-401(A) Mathematical Computation by Physical Means** 2-2

A wide variety of elementary devices which may be used to perform mathematical operations is considered together with instruments which combine them so as to solve problems largely without human intervention.

Text: Murray: Theory of Mathematical Machines; Korn and Korn: Electronic Analog Computers; M. Fry: Designing Computing Mechanisms (Machine Design 1945-46); reprints of other articles.

Prerequisite: Ma-103(B) or Ma-113(B).

**Ma-501(A) Theory of Games** 4-0

This course presents the basic concepts and foundations for the theory of games, such as game, play, strategy, complete and incomplete information, zero-sum games, etc. The structures of various games are investigated, particularly one-person games and two-person zero-sum games with finite and infinite strategies. The related algebra of matrices and bilinear forms is presented to yield methods for evaluating games. The minimax theorem is presented and properties of minimax strategies are brought out. Games involving three or more persons are taken up and the effects of coalitions studied.

Text: Von Neumann and Morgenstern: Theory of Games and Economic Behavior; Rand Reports; University of Michigan Reports; McKinsey: Theory of Games; Wald: Statistical Decision Functions; departmental notes.

Prerequisite: Ma-383(A).

# MECHANICS

Mc Courses



**Mc-101(C) Engineering Mechanics I** 3-0

Review of statics; the free body; distributed forces; centroids; the principle of virtual displacements; stability of equilibrium, rectilinear kinematics and dynamics of a particle; free vibration; forced vibration with and without damping; the principle of impulse and momentum and the principle of work and energy for rectilinear motion; potential energy and conservation of energy; dimensional analysis.

Text: Timoshenko and Young: Engineering Mechanics.

Prerequisite: A special review course in mechanics or the equivalent, and Ma-100.

**Mc-102(C) Engineering Mechanics II** 3-0

The differentiation of vectors; kinematics and dynamics and the curvilinear motion of a particle; angular momentum; motion of a rigid body about a fixed axis; moments and products of inertia; plane motion of a rigid body; time rate of change of a vector presented in a moving coordinate system. principle of the moment of momentum; gyroscope; Coriolis acceleration.

Text: Timoshenko and Young: Engineering Mechanics; Phillips: Vector Analysis.

Prerequisite: Mc-101(C).

**Mc-201(A) Methods in Dynamics** 2-2

The principles of (a) linear momentum, (b) angular momentum, (c) work and energy, (d) power and energy, (e) conservation of energy, (f) virtual work, and (g) d'Alembert are developed and discussed in detail. This work is followed by a development and interpretation of Lagrange's equations of motion. The application of these various principles to obtain the differential equations of motion of dynamical systems is given particular attention. Numerous exercises in the writing of differential equations of motion are assigned. Some of these exercises are designed to furnish practice in the formulation of the differential equations for systems of variable mass.

Text: Synge and Griffith: Principles of Mechanics; Timoshenko and Young: Aavanced Dynamics.

Prerequisite: Mc-102(C) and Ma-103(B). (Latter may be taken concurrently.)

**Mc-311(A) Vibrations** 3-2

Kinematics of vibrations; harmonic analysis; free and forced vibrations of systems with one degree of freedom; theory of vibration measuring instruments and of vibration insulation; systems with many degrees of freedom; normal modes of vibration; computation of fastest and slowest modes by matrix methods; vibrations of strings, beams, shafts and membranes; Rayleigh's method; Stodola's method; critical speeds; self-excited vibrations; effect of impact on elastic structures.

Text: Den Hartog: Mechanical Vibrations (3rd edition); Frankland: Effects of Impact on Simple Elastic Structures (TMB Report 481).

Prerequisite: Ma-104(A), Mc-102(C), ME-500(C).

**Mc-401(A) Exterior Ballistics** 3-0

Topics presented include the vacuum trajectory; density and temperature structure of the atmosphere; application of dimensional analysis to the problem of air resistance; theory of longitudinal elastic waves in air; numerical integration of differential equations of motion under standard conditions; differential corrections for abnormal conditions; weighting factors; integration of the adjoint system; exact and approximate construction of firing tables for aircraft machine guns. The projectile is treated as a mass particle, stability considerations being deferred to a later course, Mc-402(A).

Text: McShane, Kelley and Reno: Exterior Ballistics; Scarborough: Numerical Mathematical Analysis (1st edition).

Prerequisite: Mc-102(C).

**Mc-402(A) Dynamics of Missiles and Gyros** 3-0

The fundamental principles of the dynamics of rotating rigid bodies are emphasized throughout the

course. These principles are applied to a variety of mechanical systems in an effort to demonstrate their wide applicability. Among the applications discussed are the motion of a gyroscope in the gyrocompass, latitude measuring devices and stable elements; the stability, drift and trailing of spinning shells and rockets in flight.

Text: Synge and Griffith: Principles of Mechanics (2nd Edition); Nielsen and Synge: Motion of a Spinning Shell; Timoshenko and Young: Advanced Dynamics.

Prerequisite: Mc-401(A).

**Mc-421(A) Interior Ballistics** 2-0

Basic thermodynamics of interior ballistics including methods of determining the adiabatic flame temperature, specific heat and number of moles of powder gas. These basic topics are followed by a detailed study (including computational exercises) of the linear system of interior ballistics of Hirschfelder developed under NDRC auspices. The contribution of modern interior ballistic theory to the problem of gun design is emphasized.

Text: Hirschfelder and Sherman: Simple Calculation of Thermochemical Properties for Use in Ballistics (OSRD Report 935); Curtiss and Wrench: Interior Ballistics (OSRD Report 6468).

Prerequisite: Ma-111(C), Mc-102(C), Ch-631(A).

**Mc-431(A) Theory of Plasticity of Metals and Strength of Guns** 3-0

A detailed presentation of the modern mathematical theory of the plasticity of metals; criterion of yielding; strain-hardening; the complete stress-strain relations; Levy-Mises and Reuss equations; Hencky stress-strain equations; the plastic potential; variational principles, solutions of plastic-elastic problems; expansion of spherical shells and cylindrical tubes; theory of the autofrettage process used in the radial expansion of guns.

Text: Hill: Mathematical Theory of Plasticity; Jeansen: Treatise on the Radial Expansion of Guns.

Prerequisite: Ma-114(A), Mc-102(C), ME-500(C).

# MECHANICAL ENGINEERING

ME Courses



**ME-111(C) Engineering Thermodynamics** 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy function. Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic properties of liquids and vapors in equilibrial and metastable states, property tables and diagrams, representative reversible and irreversible processes in vapor and liquid phases. Property relations, tables and diagrams for ideal or quasi-ideal gases, representative reversible and irreversible processes with these. Kinetic theory of gases. Associated problems.

**Text:** Kiefer, Kinney and Stuart: Engineering Thermodynamics.

**Prerequisite:** Ma-102(C).

**ME-112(B) Engineering Thermodynamics** 4-2

Properties of mixtures of quasi-ideal gases, low-pressure gas-vapor mixtures and related indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion and other representative processes, multi- and mono-pressure hygrometric diagrams. Non-ideal gases, their p-v-T correlation by equation and by compressibility diagrams, residual enthalpy and entropy functions and their determination from compressibility and throttling data, representative processes and generation of thermodynamic diagrams. Combustion of fuels and material balances, fuel calorimetry, chemical equilibrium and equilibrium constant rich-mixture and thin-mixture combustion, flame temperatures. Associated problems.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-111(C).

**ME-122(C) Engineering Thermodynamics** 3-2

Studies included are as indicated for course ME-112 except for omission of considerations of the thermodynamic properties and property correlations for non-ideal gases.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-111(C).

**ME-131(C) Engineering Thermodynamics** 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy property, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic characteristics of liquids and vapors. Property relations, tables and diagrams for ideal or quasi-ideal gases and representative reversible and irreversible processes with these. Gas mixtures, low-pressure gas-vapor mixture and their indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion, multi- and mono-pressure hygrometric charts.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: Ma-102(C).

**ME-132(C) Engineering Thermodynamics** 3-2

Materials and energy balance in combustion. Spark-ignition engine and simpler gas-turbine power installations and their performance characteristics. Subsonic and supersonic flow of compressible fluids, reversible and shockwise, in nozzle, diffuser or duct; associated wall forces and their operation in turbine or compressor blading and in jet propulsion or the rocket motor. Elements of heat transmission. Sequent to ME-131, those thermodynamic applications are considered which are of major concern in aircraft power installations.

Text and Supplements: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: ME-131(C).

**ME-141(C) Engineering Thermodynamics** 4-2

The fundamental concepts of thermodynamics; energy and its accounting; availability and entropy of energy; the thermodynamic properties of pure substances and their changes in various processes, including chemical interaction. Emphasis is placed on those topics essential for subsequent studies of torpedo power plants, jet engines, explosives and similar applications where non-standard fluids are involved. The laboratory periods are used for student solution of practical problems chosen to illustrate the principles discussed in the classroom.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: Ma-103(B).

**ME-142(A) Engineering Thermodynamics** 2-2

Organization of the thermodynamic properties of non-ideal gases through the use of the residual functions preparation and use of thermodynamic diagrams for simple systems of ideal and non-ideal gases and for complex systems in chemical equilibrium, heat, and work effects in representative processes involving complex mixtures such as the products of combustion. This course is a continuation of ME-141(C). The laboratory periods are used for student solution of practical problems to illustrate the principles discussed in the classroom.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-141(C).

**ME-143(A) Engineering Thermodynamics** 4-4

Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of the jet and diverted flow. Application of thermodynamic facilities to power plants such as jet engines and torpedo motors which operate on non-standard fluids. Turbine nozzle and blading design factors and performance indices. Elements of heat transfer. Associated problems.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Church: Steam Turbine.

Prerequisite: ME-142(C).

**ME-150(C) Thermodynamics** 4-2

Fundamental aspects of energy accounting at molecular and atomic levels, and its mechanical availability. Thermodynamic properties of actual gases, correlation with the kinetic theory, property changes and their correlation in representative processes and accompanying work effects. Reversible and shockwise flow of gases and shock propagation.

Text and Supplements: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: Ma-181(C).

**ME-211(C) Marine Power Plant Equipment** 3-2

Steam power plant cycles, internal combustion power cycles, elementary gas turbine power plant, influences of regenerative pre-heating and of reheating, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of jet and of diverted flow. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-112(B).

**ME-212(C) Marine Power Plant Equipment** 3-4

Thermodynamic aspects of the turbine, impulse gas compressor and blower. Refrigeration and heat and reaction types, of the reciprocating engine, the pump cycles, refrigerants, multi-level refrigeration. Air conditioning; requirements and equipment, associated laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Raber and Hutchinson: Refrigeration and Air Conditioning; miscellaneous supplementary material.

Prerequisite: ME-211(C).

**ME-215(A) Marine Power Plant Analysis and Design** 2-4

Studies of the methods and procedures employed in the over-all planning of naval ships from the viewpoint of the power plant engineer, their principal plant components and various practical and military factors which influence the design. Project work includes preliminary methods of estimating for a hypothetical naval ship: the hull, main engine and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various ship and plant performance indices. The time is distributed variously between lectures, student project work, seminar and, upon occasion, lectures by visiting authorities in specialized fields of naval marine engineering.

Text: Seward: Marine Engineering; Labberton: Marine Engineering; Bureau of Ships publications and data; Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-212(C); ME-310(B) and ME-411(C).

**ME-216(A) Marine Power Plant Analysis and Design** 2-4

This course, in continuation of ME-215(A), carries to completion the project work of the latter, as required, with additional project work in preliminary design investigation of main propulsion turbines and other major equipment items; study of power plant performance of representative naval power plants by analysis of heat balance and flow diagrams. The time is distributed variously between lectures, student project work, seminar and, upon occasion, lectures by visiting authorities in specialized fields of naval marine engineering.

Text: Seward: Marine Engineering; Labberton: Marine Engineering; Church: Steam Turbines; Bureau of Ships publications and data; Kiefer, Kinney and Stuart: Engineering Thermodynamics.

Prerequisite: ME-215(A).

**ME-217(C) Internal Combustion Engines (Diesel)** 4-2

The studies include the thermodynamic analysis of the fundamental cycle, ideal and actual combustion processes, cyclic processes, injection phenomena and methods of injection system analysis, and the variables that affect the efficiency and performance of the engine. The laboratory work includes a series of tests on various engines to determine volumetric and mechanical efficiency, speed-torque characteristics, fuel consumption rates, effect of injection system variables upon engine performance, analysis of high speed engine indicator card, etc.

Text: Lichty: Internal Combustion Engine; Taylor and Taylor: Internal Combustion Engine; Heldt: High Speed Diesel Engines.

Prerequisite: ME-112(B) or 122(C).

**ME-221(C) Marine Power Plant Equipment** 3-2

Steam power plant cycles, influences of regenerative feed heating and of reheating, performance indices. Internal combustion power cycles, elementary gas turbine power plant, influence of regenerative preheating and of reheating, performance indices. Thermodynamic aspects of flow of compressible fluids in nozzle, diffuser and duct, dynamics of jet and of diverted flow. Elements of heat transmission. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-122(C).

**ME-222(C) Marine Power Plant Equipment** 3-4

Thermodynamic aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration, air conditioning requirements and equipment. Associated laboratory work.

Text: Kiefer, Kinney and Stuart: Engineering Thermodynamics; miscellaneous supplementary material.

Prerequisite: ME-221(C).

**ME-223(B) Marine Power Plant Analysis** 2-4

Preliminary methods of estimating for a hypothetical naval ship the hull, main engine and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various plant and ship performance indices. Preliminary design investigation of main propulsion turbines and other power plant equipment. Study of one or more representative naval power plants by analysis of heat balance and flow diagrams.

Text: Seward: Marine Engineering; Labberton: Marine Engineering; Church: Steam Turbines; Bureau of Ships publications and data.

Prerequisite: ME-222(C) and ME-421(C).

**ME-310(B) Heat Transfer** 3-2

General manners of energy transition by temperature potential, characteristic thermal circuits, concepts and correlation of individual and overall heat transfer coefficients. Fourier's general law of conduction, applications to representative steady-state situations and unsteady-state conditions, Schmidt and relaxation methods of approximation. Convection phases of thermal circuits, free and forced, and ones involving vaporization and condensation. Heat radiation. Associated problems and laboratory work.

Text: Jakob: Heat Transfer, Vol. 1; Miscellaneous supplementary material.

Prerequisite: ME-112(B), ME-411(C).

**ME-350(C) Heat Transfer** 2-2

General survey of the manners of energy transition by temperature potential, with major emphasis on its transfer by radiation and conduction under steady and unsteady-state conditions.

Text: Jakob: Heat Transfer, Vol. I; McAdams: Heat Transmission.

Prerequisite: Ma-182(C).

**ME-411(C) Hydromechanics** 3-2

The mechanical properties of liquids, hydrostatic pressures and forces on submerged surfaces and associated matters of buoyancy and ship stability. Energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control, hydraulic force-transmission and arrester systems. Dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling, etc. The principle of dynamic similarity and dimensional analysis are developed and employed extensively. The laboratory periods are used for student's solution of related practical problems and for related laboratory tests.

Text: Departmental notes (PG stencil No. 2217); Mechanics of Hydraulic Equipment.

Prerequisite: Ma-103(B).

**ME-412(A) Hydromechanics** 4-2

Fluid-flow kinematic concepts; fundamentals of frictionless fluid flow; theorems and basic flow definition utilizing vector calculus; three-dimensional flow examples; application of complex variables to two-dimensional fluid flow; two-dimensional flow examples; Blasius theorem—flow around cylinders and airfoils; Schwarz—Christoffel theorem—free streamlines; vortex motion; equations for viscous flow: the boundary layer.

Text: Streeter: Fluid Dynamics.

Prerequisite: ME-411(C) and Ma-104(A).

**ME-421(C) Hydromechanics** 3-2

Mechanical properties of fluids; hydrostatic pressures and forces; buoyancy and stability; energy of flow; resistance to flow; fluid flow metering; hydraulic force and arrester systems.

Text: Departmental notes (PG Stencil No. 2217); Mechanics of Hydraulic Equipment.

Prerequisite: Ma-102(C) or equivalent.

**ME-422(B) Hydromechanics** 2-2

Dynamic forces associated with fluid flow; centrifugal pumps; hydrodynamic coupling; dimensional analysis and dynamical similarity. Introduction to the kinematics of flow; stream function and velocity potential; graphical mapping of stream lines. Elements of the theory of hydrodynamic lubrication.

Text: Departmental notes (PG Stencil No. 2217); Mechanics of Hydraulic Equipment.

Prerequisite: ME-421(C) and Ma-103(B) or the equivalent.

**ME-441(B) Hydromechanics** 4-2

Mechanical properties of fluids. Hydrostatic pressures and force distribution, submerged surfaces. Energy aspects of flow; resisitance to laminar and turbulent flow in ducts, with introduction to the correlation of relevant variables through the principle of dynamic similarity and use of dimensional analysis. Flow metering and control by orifice, elements of hydraulic arrester. Dynamics of flow in representative devices, and performance correlations by dynamic similarity principle. Introduction

to the concepts of the stream function, velocity potential, sourse, sink and free vortex, and their synthesis to form simpler irrotational flow patterns. Brief survey of the utilization of vector calculus and the complex variable in analysis of more complex patterns.

Text: Kiefer and Drucker: departmental notes.

Prerequisite: Ma-153(B) and Ma-154(A).

**ME-442(B) Compressible-fluid Flow** 2-2

Review of general thermodynamic principles, and of the thermodynamic properties and property relation for gaseous fluids. Thermodynamics of the subsonic and supersonic flow of compressible fluids, reversible and shockwise, in nozzle or diffuser and about simpler obstructions. Associated wall forces, and their operation in jet propulsion or the rocket motor.

Text: and Supplements: Kiefer, Kinney and Stuart: Engineering Thermodynamics; Keenan and Kaye: Gas Tables.

Prerequisite: Ch-401(A) and Ch-631(A).

**ME-500(C) Strength of Materials** 3-0

Elements of the mechanics of elastic bodies; tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, torsion of circular-sectioned members, elementary beam theory, combined loadings and columns.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

**ME-511(C) Strength of Materials** 5-0

Topics in elastic-body mechanics, including tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, torsion of circular-sectioned members, elementary beam theory, statically indeterminate problems in bending, beams on elastic foundations.

Text: Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

**ME-512(A) Strength of Materials** 5-0

Beam columns, problems having radial symmetry, combined loading, columns, strain energy, thin plates, thick-walled cylinders, fundamental concepts in the theory of elasticity.

Text: Timoshenko: Strength of Materials, Vols. I and II.

Prerequisite: ME-511(C).

**ME-513(A) Theory of Elasticity** 3-0

Plane-stress considerations, differential equations of equilibrium and compatibility, the Airy stress function, curvilinear coordinates, problems in plane stress and plane strain, three-dimensional stress considerations, St. Venant theory of torsion, energy considerations.

Text: Timoshenko and Goodier: Theory of Elasticity.

Prerequisite: ME-512(A) or the equivalent.

**ME-522(B) Strength of Materials** 4-0

Beam columns, problems having radial symmetry, strain energy, fundamental concepts in the theory of elasticity.

Text: Timoshenko: Strength of Materials, Vols. I and II; Lee: An Introduction to Experimental Stress Analysis.

Prerequisite: ME-511(C).

**ME-541(C) Strength of Materials** 3-0

Stress, strain, Hooke's law, thin-walled cylinders, combined stresses, torsion of solid and hollow shafts, elementary beam theory, combined bending and torsion, combined bending and axial load, behavior of columns.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: Ma-101(C) and Mc-101(C) or equivalent.

**ME-542(B) Strength of Materials** 3-0

Statically indeterminate problems in bending, bending beyond the yield point, curved beams, strain energy, mechanical properties of materials.

Text: Timoshenko and MacCullough: Elements of Strength of Materials.

Prerequisite: ME-541(C).

**ME-550(B) Elastic Body Mechanics** 5-0

Stress, strain, Hooke's law, torsion, elementary beam theory, reinforced concrete beams, columns, simple structures under static and impact loads.

Text: Timoshenko: Strength of Materials, Vol. I.

Prerequisite: Mc-311(A).

**ME-601(C) Materials Testing Laboratory** 0-2

Performance and analysis of standard tests used in determining the mechanical properties of engineering materials, including tests in tension, compression, torsion, shear, transverse, bending, impact, hardness and fatigue.

Text: Muhlenbruch: Testing of Engineering Materials; A.S.T.M. Student Standards.

Prerequisite: Subsequent to or concurrent with ME-500(C) or ME-541(C).

**ME-611(C) Materials Testing Laboratory** 2-2

Study of the theories of failure, the evaluation of experimental error and experiments in the determination of the mechanical properties of engineering materials. These tests include: tension, compression, torsion, shear, transverse bending, impact, hardness, fatigue and column.

Text: Timoshenko: Strength of Materials, Vol. II; Davis, et al: Testing and Inspection of Engineering Materials.

Prerequisite: ME-511(C).

**ME-612(A) Experimental Stress Analysis** 3-2

The course includes: dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Diversified laboratory projects will be assigned, offering an opportunity to apply the methods of experimental stress analysis to the solution of both static and dynamic problems.

Text: Lee: Introduction to Experimental Stress Analysis.

Prerequisite: ME-513(A) and ME-611(C). ME-612(A) may be taken concurrently with ME-513(A).

**ME-622(B) Experimental Stress Analysis** 2-2

Introduction to the theory of elasticity, dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Laboratory projects will be assigned to demonstrate the several methods presented.

Text: Lee: An Introduction to Experimental Stress Analysis.

Prerequisite: ME-522(B) and ME-611(C) or equivalent.

**ME-700(C) Kinematics of Machinery** 3-2

This is a general service course. The following topics are studied: link-work, cams, toothed gearing, trains of mechanisms, velocities, accelerations, static forces and inertia forces in machine members. The practical work periods are devoted to the solution on the drawing board of selected problems.

Text: Ham and Crane: Mechanics of Machinery.

Prerequisite: MC-102(C).

**ME-711(B) Mechanics of Machinery** 3-2

Topics considered briefly include link-works, cams and gears. Major emphasis is on the velocities and accelerations of moving parts, static and inertia forces and their balancing, critical speeds in shafts.

Text: Ham and Crane: Mechanics of Machinery.

Prerequisite: MC-102(C).

**ME-712(A) Dynamics of Machinery** 3-2

Studies are made of the following topics: balancing of solid rotors, torsional vibrations by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the reciprocating engine. Laboratory work includes the following experiments: balancing a solid rotor on a mechanical as well as an electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Text: Den Hartog: Mechanical Vibrations; Notes by E. K. Gatcombe.

Prerequisite: Ma-104(A), Mc-201(A), ME-711(C) and ME-511(C).

**ME-730(B) Dynamics of Machinery** 3-2

Studies are made of the following topics: balancing of solid rotors, torsional vibration analysis by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the radial aircraft engine. The laboratory work includes the following experiments: balancing of solid rotors on the mechanical as well as the electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment and operating a torsional vibration inducer unit.

Text: Den Hartog: Mechanical Vibrations; Notes by E. K. Gatcombe.

Prerequisite: Ma-104(A), Mc-201(A), Ae-202(C).

**ME-740(C) Kinematics and Machine Design** 3-2

Studies are made of the following topics: displacements, velocities, and accelerations of the various kinematic linkages, such as the four bar mechanism, the drag link, cams, gears, intermittent motions, cyclic gears and gyros. Several design topics will be considered: the design of shafting; (considering strength, deflection, bearing loads, critical speeds etc.); couplings; springs; bearings fits and tolerances.

Text: Ham and Crane: Mechanics of Machinery; machine design notes by E. K. Gatcombe.

Prerequisite: Mc-102(C), ME-542(B).

**ME-811(C) Machine Design** 3-2

Review of strength of materials, selections of materials, stress-concentration, bearings, fits and tolerances. Several short design projects as follows: tabulation of tolerances for shafts and holes for the various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams and thin and thick cylinders.

Text: Vallance: Design of Machine Elements; notes by E. K. Gatcombe.

Prerequisite: ME-511(C) or equivalent, ME-711(B).

**ME-812(B) Machine Design** 3-4

Several practical design projects will be completed on the drawing board. The projects will give the students an opportunity to combine theory with practice. The drawings involved in the projects will be completely dimensioned; proper materials selected; correct base references, surfaces for machining and inspecting will be chosen; proper fits and tolerances will be chosen for interchangeable manufacture. The objective is to create designs which may actually be fabricated.

Text: Notes by E. K. Gatcombe.

Prerequisite: ME-811(C).

**ME-820(C) Machine Design** 2-4

Short review of strength of materials. Stress-concentration, factors of safety. Fits and tolerances. Several short design projects which illustrate the application of the principles of stress, strain deflections, fits and tolerances, vibrations, etc. General design information on bearings, springs shafting, screw fastenings, gears, clutches, brakes, cams and thick and thin cylinders.

Text: Notes by E. K. Gatcombe.

Prerequisite: ME-700(C).

Reference: Vallance: Design of Machine Members.

**ME-830(C) Machine Design** 4-2

Review of strength of materials, selections of materials for different designs. stress-concentration, bearing design, fits and tolerances. Several short design projects as follows: tabulation of tolerances for shafts and holes for various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams and thin and thick cylinder design.

Text: Vallance: Design of Machine Members; Notes by E. K. Gatcombe.

Prerequisite: ME-700(C), Ae-202(C).

**ME-840(C) Manufacturing Engineering** 3-2

The following topics are studied: the principles of interchangeable manufacture, the selection of and use of the proper machine tools to fulfill a specific requirement, the details of gage design and inspection methods with reference to proper fits and tolerances. Several industrial plants will be visited, where lectures on the use of machines will be provided.

Text: Buckingham: Interchangeable Manufacturing.

Prerequisite: ME-811(C).

# METALLURGY

Mt Courses



**Mt-101(C) Production Metallurgy** 2-0

This course serves as an introduction to the study of metallurgy and is essentially descriptive in nature. Subjects treated include: the occurrence and classification of metal-bearing raw materials; the fundamental processes of extractive metallurgy; refractories, fuels, fluxes, slags and equipment; a brief summary of steel-making and the production of copper and zinc.

**Text:** Stoughton, Butts: Engineering Metallurgy (1938).

**Prerequisite:** Ch-101(C), Ch-121(B) or concurrently with either.

**Mt-102(C) Production of Steel** 3-0

The subject matter includes such topics as the occurrence and composition of various iron ores; the blast furnace, its design and operation; blast furnace products. The various methods of steel production and the production of gray, white and malleable cast iron.

**Text:** Bray: Ferrous Production Metallurgy.

**Prerequisite:** Ch-101(C) or Ch-121(B).

**Mt-103(C) Production of Non-Ferrous Metals** 3-0

The subject matter of this course includes a discussion of the sources, the strategic importance of, and the methods of production of the following metals: copper, zinc, lead, tin, aluminum, magnesium, and other metals of technical interest.

**Text:** Bray: Non-Ferrous Production Metallurgy.

**Prerequisite:** Ch-101(C) or Ch-121(B).

**Mt-201(C) Introductory Physical Metallurgy** 3-2

This course serves as an introduction to physical metallurgy. Subjects treated include: (a) the nature, characteristics and properties of metals; (b) the application of the phase rule to binary and ternary alloy systems and characteristic phase diagrams; (c) the correlation of microstructure and mechanical properties and corrosion resistance of alloys, with phase diagrams; (d) mechanical deformation and heat treatment of alloys; and (e) descriptions of representative non-ferrous alloys of commercial importance. The subject matter is illustrated by reference to technically important alloy systems in which the phenomena are commonly observed. The laboratory experiments are designed to introduce to the student the methods available to the metallurgist for the study of metals and alloys. These include the construction of equilibrium diagrams and metallographic studies of fundamental structures, brass, bronze, bearings, etc.

**Text:** Coonan: Principles of Physical Metallurgy; Heyer: Engineering Physical Metallurgy.

**Prerequisite:** Ch-101 or equivalent.

**Mt-202(C) Ferrous Physical Metallurgy** 3-2

This course continues the presentation of subject matter introduced in Metals, Mt-201, with emphasis on the alloys of iron. Subjects treated include: (a) the iron-carbon alloys; (b) effects of various heat treatments and cooling rates on the structure and properties of steel; (c) isothermal reaction rates and the hardenability of steel; (d) surface hardening methods; (e) characteristics and properties of plain carbon and alloy cast irons ; (f) the effect of other alloying elements on steel; (g) tool steels; (h) corrosion and corrosion resisting steels.

The laboratory work includes experiments in the heat treatment of steel, mechanical testing and metallographic examination of common ferrous alloys.

**Text:** Coonan: Principles of Physical Metallurgy; Heyer: Engineering Physical Metallurgy.

**Prerequisite:** Mt-201(C).

**Mt-203(B) Physical Metallurgy (Special Topics)** 2-2

This course is a continuation of material presented in Mt-201(C) and Mt-202(C). The subject matter

covered includes discussions of casting and welding, developments in powder metallurgy, creep and fatigue of metals, material defects and non-destructive testing, light alloys, and the special characteristics of alloys for electrical purposes, armor and armament, titanium and strategic materials.

Text: Heyer: Engineering Physical Metallurgy; Coonan: Principles of Physical Metallurgy; Woldman: Heat Treating Aluminum Alloys; Reynolds Metal Company: Selected outside reading.

Prerequisite: Mt-202(C).

**Mt-204(A) Physical Metallurgy** 3-4

The material presented in this course includes a study of phase transformations in steel; isothermal decomposition reactions and products; decomposition on continuous cooling; factors involved in hardenability and methods of evaluating it; time, temperature, transformation, mechanical and heat treatment of steel; alloy steels, high strength cast irons and cast steels.

Text: Bullens: Steel and Its Heat Treatment, Vol. I, II, III, 5th Edition.

Prerequisite: Mt-201(C), Mt-202(C).

**Mt-205(A) Advanced Physical Metallurgy** 3-4

The subject matter includes a discussion of equilibrium in alloy systems, structure of metals and alloys, phase transformations and diffusion.

Text: Barrett: Structure of Metals.

Prerequisite: Mt-202(C).

**Mt-206(A) Advanced Physical Metallurgy** 3-4

The subject matter is an extension of that offered in Mt-205(A) and includes such topics as plastic deformation, theories of slip, recrystallization, preferred orientation, age hardening, etc.

Text: Barrett: Structure of Metals; Chalmers: Progress in Metal Physics.

Prerequisite: Mt-205(A).

**Mt-301(A) High Temperature Materials** 3-0

This course includes a study of the methods used in evaluating the probable behavior of materials at elevated temperatures, a consideration of the properties of particular importance in such service; evaluation of present heat resisting alloys; a study of the effect of high temperature on the behavior of alloys; metals used in gas turbines, jets, and rockets; the use of ceramics for elevated temperatures.

Text: None.

Prerequisite: Mt-202(C).

**Mt-302(A) Alloy Steels** 4-2

The subject matter covered includes a thorough study of the effects of the alloying elements, including carbon, commonly used in steel-making; on the characteristics of steels in the annealed, the hardened, and the hardened and tempered conditions. The principles elucidated are subsequently applied to studies of the classes of steels used for structural purposes, machinery (S. A. E. and A. I. S. I. grades), electrical purposes, tools, and corrosion-resisting purposes.

Text: E. C. Bain: The Alloying Elements in Steel; References and reading assignments in other books and current literature.

Prerequisite: Mt-202(C), Mt-204(A).

**Mt-303(A) Metallurgy Seminar** 2-0

Papers from current technical journals will be reported on and discussed by students.

Text: None.

Prerequisite: Mt-203(B), 204(A), or 205(A).

**Mt-304(C) Radiography** 2-2

This course covers the principles of x-ray and gamma ray radiogrophy, including a discussion of high voltage equipment, film characteristics and a comparison of radiography with other non-destructive methods of inspection.

Text: None:

Prerequisite: Mt-202(C).

**Mt-401(A) Physics of Metals** 3-0

A discussion of crystal chemistry and modern theories of the solid state. Topics considered are the wave nature of electrons, the electron theory of metals, reaction kinetics, free energy of alloy phases, order-disorder transformations, etc.

Text: Cottrell: Theoretical Structure Metallurgy.

Prerequisite: Mt-205(A), Ph-610(B), or 640(B).

# ORDNANCE AND GUNNERY

Or Courses



**Or-120(C) Surface Fire Control** 2-0

Fundamentals of the surface fire control problem, rangekeeper theory, director systems, synchros, fire control errors and correctors, battery alignment, basic mechanisms, shore bombardment.

Text: Surface Fire Control (OP 1701); Naval Ordnance and Gunnery (NavPers 16116B); Basic Fire Control Mechanisms (OP 1140); Rangekeeper Mk 8 (OP 1068).

Prerequisite: None.

**Or-131(C) Antiaircraft Fire Control** 2-0

Fundamentals of the antiaircraft fire control problem, analytical solution of the antiaircraft fire control problem, computer theory, units making up a linear-rate fire control system, theory and description of disturbed line-of-sight systems, Mark 14 gunsight, Mark 20 gunsight.

Text: Naval Ordnance and Gunnery (NavPers 16116B); Mark 6 Stable Element (OP 1063); Mark 1 Computer (OP 1064); Mark 14 gunsight (OP 1040); Mark 20 gunsight (OP 1325).

Prerequisite: Or-120(C) or equivalent.

**Or-132(C) Antiaircraft Fire Control** 2-0

Continuation of Or-131(C). Mark 15 gunsight, Mark 63 GFCS, theory and description of undistrubed line-of-sight systems, Mark 57 GFCS, Mark 56 GFCS, static and dynamic errors in fire control.

Text: Naval Ordnance and Gunnery (NavPers 16116B); Mk 15 Gunsight (OP 1098); Mk 57 GFCS (OP 1323); Mk 63 GFCS (OP 1233); other Department of Defense classified publications.

Prerequisite: Or-131(C) or equivalent.

**Or-141(C) Guided Missiles** 2-0

Introduction to guided missiles and guidance systems. Survey of jet propulsion systems, launching problems, flight testing, simulators and damage potential. Organization for guided missile research and development. Study of one basic type guided missile. Guidance tactical problems and limitations of several guidance systems.

Text: Navy Department classified publications.

Prerequisite: None.

**Or-142(C) Guided Missile Guidance** 2-0

This course is a continuation of Or-141(C). Survey of guidance systems and Bureau of Ordnance guided missiles. Units making up beam rider, command, and homing systems.

Text: Navy Department classified publications.

Prerequisite: Or-141(C) or equivalent.

**Or-151(C) Underwater Ordnance** 2-0

Introduction to underwater weapons, torpedo fire control theory, theory and design of Fire Control System Mk 102, Mod 4.

Text: Naval Ordnance and Gunnery (NavPers 16116B); Depth Charge Mk 14 (OP 669); Torpedo Data Comupter Mk 3 (OP 1056); Arma Corporation: Preliminary data booklets FCS Mk 102.

Prerequisite: None.

**Or-152(C) Underwater Ordnance** 2-0

Moored and ground mines, contact and influence firing mechanisms, harbor defense, nets and booms, mine locating and sweeping.

Text: Mine Mk 6 (OP 888); Mine Mk 10 (OP 900); Mine Mk 12 (OP 901); Nets and Booms (OP 636A); Mine Accessories (OP 1452); Firing Mechanism M-11 (OP 681); Firing Mechanism A-5 (OP 1799); Firing Mechanism A-6 (OP 668); Mine Warfare Instructions (USF 12); Mine Mk 27 (OP 685).

Prerequisite: None.

# NEW WEAPONS DEVELOPMENT

SL Lecture Courses



**SL-101 New Weapons Development I** 0-1

This course consists of the first ten lectures of a twenty-lecture series to be delivered by authorities in the field of new weapons development, the latter term being used in its broadest sense and including such developments as atomic energy, guided missiles, pilotless aircraft, radar, special communication equipment, countermeasures, special fuzes and jet propulsion.

Text: None.

Prerequisite: None.

**SL-102 New Weapons Development II** 0-1

This course is a continuation of Course SL-101 and consists of the second ten lectures of the twenty-lecture series described under SL-101.

Text: None.

Prerequisite: None.

# OPERATIONS ANALYSIS

Oa Courses



**Oa-101(C) Introductory Problems in Operations Analysis** 2-0

Problems involving only a few sharply defined variables with relations among them that are directly observable. Example: evaluation of evasive maneuvers of a ship attacked by a suicide airplane.

Text: Operations Evaluations Group: Report No. 54, Methods of Operations Research; Navy Department Classified Reports.

Prerequisite: Ma-182(B), Ma-381(B).

**Oa-101(B) Theoretical Methods in Operations Analysis** 5-0

Problems involving only a few sharply defined variables, with relations among them that require theoretical analysis. Examples: probability of a hit by a succession of shots; probability of detection by a succession of scans.

Text: Navy Department Classified Reports.

Prerequisite: Oa-100(C), Ma-382(A).

**Oa-102(A) Weapon Systems and Combined Operations** 4-0

Problems involving many variables or vaguely defined variables. Examples: selection of optimum airplane-weapon system for anti-submarine patrol; the control of formation bombing; the comparison of strategies.

Text: Navy Department Classified Reports.

Prerequisite: Oa-101(B).

**Oa-103(A) Selected Topics in Operations Analysis** 5-3

Problems involving special concepts or special techniques. Examples: applications of game theory; linear programming and inventory control; human engineering.

Text: Navy Department Classified Reports.

Prerequisite: Oa-102(A), Ma-184(A), Ma-383(A), Ma-581(A).

# PHYSICS

Ph Courses



**Ph-113(B) Dynamics** 3-0

Kinematical and dynamical motions of a particle and of rigid bodies, energy concepts in dynamics, constrained motion, equations of Lagrange and of Hamilton, oscillations of a dynamical system. Both analytical and vector methods are used.

Text: Lindsay: Physical Mechanics.

Prerequisite: Ph-212(B); Ma-103(B), (may be taken concurrently.)

**Ph-141(B) Analytical Mechanics** 4-0

Fundamental dynamical concepts, oscillator theory, curvilinear motion in a plane, energy concepts, statics and dynamics of a rigid body. Both analytical and vector methods are used.

Text: Lindsay: Physical Mechanics; Page: Introduction to Theoretical Physics; Synge and Griffith: Principles of Mechanics.

Prerequisite: MA-182(B), (may be taken concurrently.)

**Ph-142(B) Analytical Mechanics** 4-0

Wave motion, fluid mechanics, constrained motion, Hamilton's principle, Lagrange's equations.

Text: None.

Prerequisite: Ph-141(B); Ma-183(B), (may be taken concurrently.)

**Ph-143(A) Analytical Mechanics** 3-0

Lagrange's and Hamilton's equations. Central force fields. Kinematic of rigid bodies. Canonical transformations.

Text: Goldstein: Classical Mechanics; Slater and Frank: Mechanics.

Prerequisite: Mc-102(C).

**Ph-190(C) Survey of Physics I** 3-0

Elementary concepts and laws of statics and dynamics. Introduction to the statics and dynamics of fluids. Temperature, heat, radiation, kinetic theory and the gas laws. Rudiments of vector representation and notation.

Text: Howe: Introduction to Physics.

Prerequisite: None.

**Ph-191(C) Survey of Physics II** 3-0

A continuation of Ph-190(C). A survey of wave propagation, sound, electricity and magnetism, atomic structure, the properties of light, and other electromagnetic wave phenomena.

Text: Howe: Introduction to Physics.

Prerequisite: Ph-190(C) or equivalent.

**Ph-196(C) Review of General Physics** 5-0

A short review of statics and dynamics. A survey of temperature, heat, kinetic theory, electricity and magnetism, wave motion and sound, and selected topics in light as time permits.

Text: Lemon and Ference: Analytical Experimental Physics.

Prerequisite: Ph-191(C) or equivalent.

**Ph-211(C) Optics** 3-0

Reflection and refraction of light, lenses and lens aberrations, stops, optical systems, and dispersion.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C), (may be taken concurrently.)

**Ph-212(B) Physical Optics and Introductory Dynamics** 3-3

A continuation of Ph-211(C). An analytical presentation of interference, diffraction, polarization, origin of spectra, optical behavior of radio waves, introductory dynamics. Related laboratory work is included.

Text: Jenkins and White: Fundamentals of Optics; Lindsay: Physical Mechanics.

Prerequisite: Ph-211(C); Ma-102(C), (may be taken concurrently.)

**Ph-240(C) Geometrical and Physical Optics** 3-3

Reflection and refraction of light, lenses, optical systems, dispersion, interference, diffraction, polarization.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C) or 181(B), (may be taken concurrently.)

**Ph-241(B) Polarized Light** 1-3

Primarily a laboratory course in polarized light. The following experiments are included: polarization phenomena caused by transmission of light through crystals, polarization by reflection from dielectrics, reflection from metals and optical constants of metals, analysis of elliptically polarized light, wave plates, and optical activity.

Text: Lecture notes.

Prerequisite: Ph-240(C) or Ph-250(C).

**Ph-250(C) Geometrical and Physical Optics** 3-2

Reflection and refraction of light, lenses, lens systems, dispersion, interference, diffraction.

Text: Jenkins and White: Fundamentals of Optics.

Prerequisite: Ma-101(C) or 181(B), (may be taken concurrently.)

**Ph-311(B) Electrostatics and Magnetostatics** 3-0

Coulomb's law, Gauss' law, dipoles, dielectric theory, polarization, harmonic solutions of Laplace's equation, electrical images, magnetic dipoles and shells, Ampere's law, magnetic field of current, magnetic theory. Both analytical and vector methods are used.

Text: Harnwell: Principles of Electricity and Electromagnetism.

Prerequisite: Ma-103(B); Es-112(C).

**Ph-341(C) Electricity and Magnetism** 4-2

DC and AC circuits, elementary electrostatics, vacuum tubes, coupled circuits, filters, lines, vacuum tube circuits. The treatment emphasizes the physical aspects of these phenomena.

Text: Harnwell: Principles of Electricity and Magnetism; NavShips 900,016; lecture notes.

Prerequisite: Ma-182(B), (may be taken concurrently.)

**Ph-351(A) Electricity and Magnetism** 5-0

Electrostatics, electromagnetic fields and potentials, dielectrics, Maxwell's equations, electromagnetic waves.

Text: Slater and Frank: Electromagnetism.

Prerequisite: Ph-143(A); Es-272(C).

**Ph-361(A) Electromagnetism** 3-0

Electromagnetic field theory; electrostatics, dielectrics, magnetic fields of currents; vector potential; magnetic materials; magnetomotive force; electromagnetic induction; Maxwell's equations; electromagnetic waves.

Text: Slater and Frank: Electromagnetism.

Prerequisite: Ma-104(A); EE-272(C), or equivalent.

**Ph-362(A) Electromagnetic Waves** 3-0

A continuation of Ph-361(A). Reflection and refraction of electromatic waves; wave guides; cavity resonators; electromagnetic radiation.

Text: Slater and Frank: Electromagnetism.

Prerequisite: Ph-361(A).

**Ph-410(B) Sound** 3-0

A brief survey of vibrating systems, and of the problems arising in connection with the radiation, transmission and reception of sound in air and in water.

**Text:** Kinsler, Frey: Fundamentals of Acoustics.

**Prerequisite:** Ma-102(C).

**Ph-421(A) Fundamental Acoustics** 3-0

An analytical study of the dynamics of vibrating systems including free, forced, damped, and coupled simple harmonic motion, vibrations of strings, bars, membranes, and diaphragms. A development of the acoustic wave equation. Propagation of plane waves through pipes and between different media. Propagation of spherical waves, including radiation from pulsating sphere and circular piston.

**Text:** Kinsler, Frey: Fundamentals of Acoustics.

**Prerequisite:** Ma-104(A).

**Ph-422(A) Applied Acoustics** 3-0

A continuation of Ph-421(A). An analytical treatment of acoustic resonators; acoustic impedance; effects of branches, orifices, and viscosity on propagation of plane waves through pipes; horn, loud speaker, and microphone theory and practice. Fundamentals of acoustical measurements including rating and calibration methods of microphones and loud speakers. Architectural acoustics. Fundamentals of hearing.

**Text:** Kinsler, Frey: Fundamentals of Acoustics.

**Prerequisite:** Ph-421(A).

**Ph-423(A) Underwater Acoustics** 2-3

A continuation of Ph-422(A). An analytical treatment of the piezoelectric effect and the magnetostriction effect with applications to sonar transducers and to crystal oscillators; transmission of sound in sea water, including problems of refraction, attenuation and reverberation. Physical principles and electronic circuits used in design and operation of modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operation of sonar equipment.

**Text:** NDRC Technical Summary: Principles of Underwater Sound.

**Prerequisite:** Ph-422(A).

**Ph-424(A) Sonar Systems and Developments** 3-3

Various types of sonar equipment and new developments are studied in the laboratory and in the classroom. Shock waves.

**Text:** Cole: Underwater Explosions.

**Prerequisite:** Ph-423(A) or Ph-450(B).

**Ph-425(A) Underwater Acoustics** 3-2

A continuation of Ph-421(A). An analytic treatment of the propagation of underwater acoustic waves as influenced by boundary conditions, refraction, reverberation, and attenuation. Physical characteristics of sonar transducers. Psychoacoustics, acoustic impedance, shock waves, sonar systems and developments, experimental measurements in underwater acoustics. Laboratory includes experiments in underwater acoustic measurements, sonar beam patterns, and operational characteristics of sonar equipment.

**Text:** Kinsler, Frey,: Fundamentals of Acoustics; NDRC Technical Summary: Principles of Underwater Sound; NDRC Technical Summary: Physics of Sound in the Sea.

**Prerequisite:** Ph-421(A).

**Ph-426(B) Acoustics Laboratory** 0-3

A laboratory course to accompany Ph-421(A). An experimental study of vibrating systems and acoustic radiations.

**Text:** None.

**Prerequisite:** Ph-421(A) concurrently.

**Ph-427(B) Fundamental and Applied Acoustics** 4-0

A study of the dynamics of vibrating systems and of the propagation of acoustic waves. Applications of basic acoustic theory to design of resonators, filters, loudspeakers, microphones, etc.

**Text:** Kinsler, Frey: Fundamentals of Acoustics.

**Prerequisite:** Ma-103(A).

**Ph-428(B) Underwater Acoustics** 2-3

A continuation of Ph-427(B). A study of the transmission of sound in sea water including problems arising from refraction, absorption, reverberation, background noise, etc. Physical principles, electronic circuits, and transducers used in modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operational characteristics of sonar equipment.

**Text:** NDRC Technical Summary: Principles of Underwater Sound.

**Prerequisite:** Ph-427(B).

**Ph-441(A) Longitudinal Waves in Fluids** 4-0

Simple oscillator. Hydrodynamics. Longitudinal wave equation. Wave propagation in fluids. Propagation of shock waves in fluids.

Text: Kinsler, Frey: Fundamentals of Acoustics; Cole: Underwater Explosions.

**Prerequisite:** Ma-183(B); Ph-143(A).

**Ph-450(B) Underwater Acoustics** 3-2

An analytic treatment of the fundamentals of acoustics, with particular emphasis on sound radiation and transmission problems encountered in underwater acoustics.

Text: Kinsler, Frey: Fundamentals of Acoustics; NDRC Technical Summary: Principles of Underwater Sound; NDRC Technical Summary; Physics of Sound in the Sea.

**Prerequisite:** Ma-102(C).

**Ph-530(B) Thermodynamics** 3-0

Fundamental theory of thermodynamics and application to physical problems. First and second laws of thermodynamics, entropy, free energy, the phase rule, gaseous reactions, thermodynamics of dilute solutions, specific heats of gases, the Nernst heat theorem.

Text: Sears: Thermodynamics.

**Prerequisite:** Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B).

**Ph-540(B) Kinetic Theory and Statistical Mechanics** 3-0

Properties of an ideal gas, Maxwell-Boltzman distribution, mean free path, collision cross-section, non-ideal gases, viscosity, heat conductivity, diffusion; introduction to classical and quantum statistics, including Fermi-Dirac and Bose-Einstein statistics.

Text: Kennard: Kinetic Theory of Gases; Sears: Thermodynamics; Lecture notes.

**Prerequisite:** Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B).

**Ph-541(B) Kinetic Theory and Statistical Mechanics** 4-0

Maxwell-Boltzman distribution, collision cross-sections, introduction to classical and quantum statistics, with application to radiant energy.

Text: Kennard: Kinetic Theory; Sears: Thermodynamics.

**Prerequisite:** Ma-183(B); Ph-143(A).

**Ph-610(B) Atomic Physics** 3-0

Elementary charged particles, photoelectricity, X-rays, radioactivity, atomic structure, nuclear reactions.

Text: Semat: Atomic Physics.

**Prerequisite:** None.

**Ph-631(B) Atomic Physics** 4-0

Dynamics of elementary charged particles, Rutherford's model of the atom and the scattering of alpha particles, special theory of relativity, black-body radiation, Bohr model of the atom, Schroedinger wave equation, dipole radiation, optical spectra, Zeeman effect, magnetic moments, Pauli's principle, x-rays, photoelectric effect, natural radioactivity, the nucleus, artificial radioactivity.

Text: Semat: Atomic Physics; Richtmeyer and Kennard: Introduction to Modern Physics.

**Prerequisite:** Ph-311(B) or equivalent.

**Ph-640(B) Atomic Physics** 3-3

Same as Ph-631(B) above, together with laboratory work.

Text: Semat: Atomic Physics; Richtmeyer and Kennard: Introduction to Modern Physics.

**Prerequisite:** Ph-361(B) or equivalent.

**Ph-641(B) Atomic Physics** 3-3

Elementary charged particles, atomic structure, Bohr model of the atom, special theory of relativity, photoelectricity, X-rays and optical spectra.

Text: Richtmeyer and Kennard: Modern Physics.

**Prerequisite:** Ph-143(A); Ph-250(C).

**Ph-642(A) Nuclear Physics** 3-0

Nuclear structure, radioactivity, nuclear reactions and nuclear fission.

Text: Bitter: Nuclear Physics.

**Prerequisite:** Ph-740(A).

**Ph-721(A) Introduction to Quantum Mechanics** 4-0

This course is designed to familiarize the student with the postulates and methods of Schroedinger's quantum mechanics, with application to such problems as the free particle, particle in a potential well, potential barriers, cold cathode emission, natural radioactivity, harmonic oscillator, free rotator, hydrogen atom and the one-dimensional potential lattice for the solid state.

Text: Lecture notes.

Prerequisite: Ph-142(B); Ph-640(B) or equivalent.

**Ph-722(A) Physics of the Solid State** 3-0

Properties of ionic crystals such as lattice energies, electrical conductivity, absorption, phosphorescence and flourescence. The transitor. Properties of metals such as specific heats, electrical conductivity and magnetic susceptibility.

Text: Seitz: Modern Theory of Solids.

Prerequisite: Ph-721(A) or equivalent.

**Ph-731(A) Theoretical Physics** 3-0

Topics in theoretical physics selected to meet the needs of the student.

Text: None.

Prerequisite: Consent of instructor.

**Ph-732(A) Theoretical Physics** 3-0

Topics in theoretical physics selected to meet the needs of the student.

Text: None.

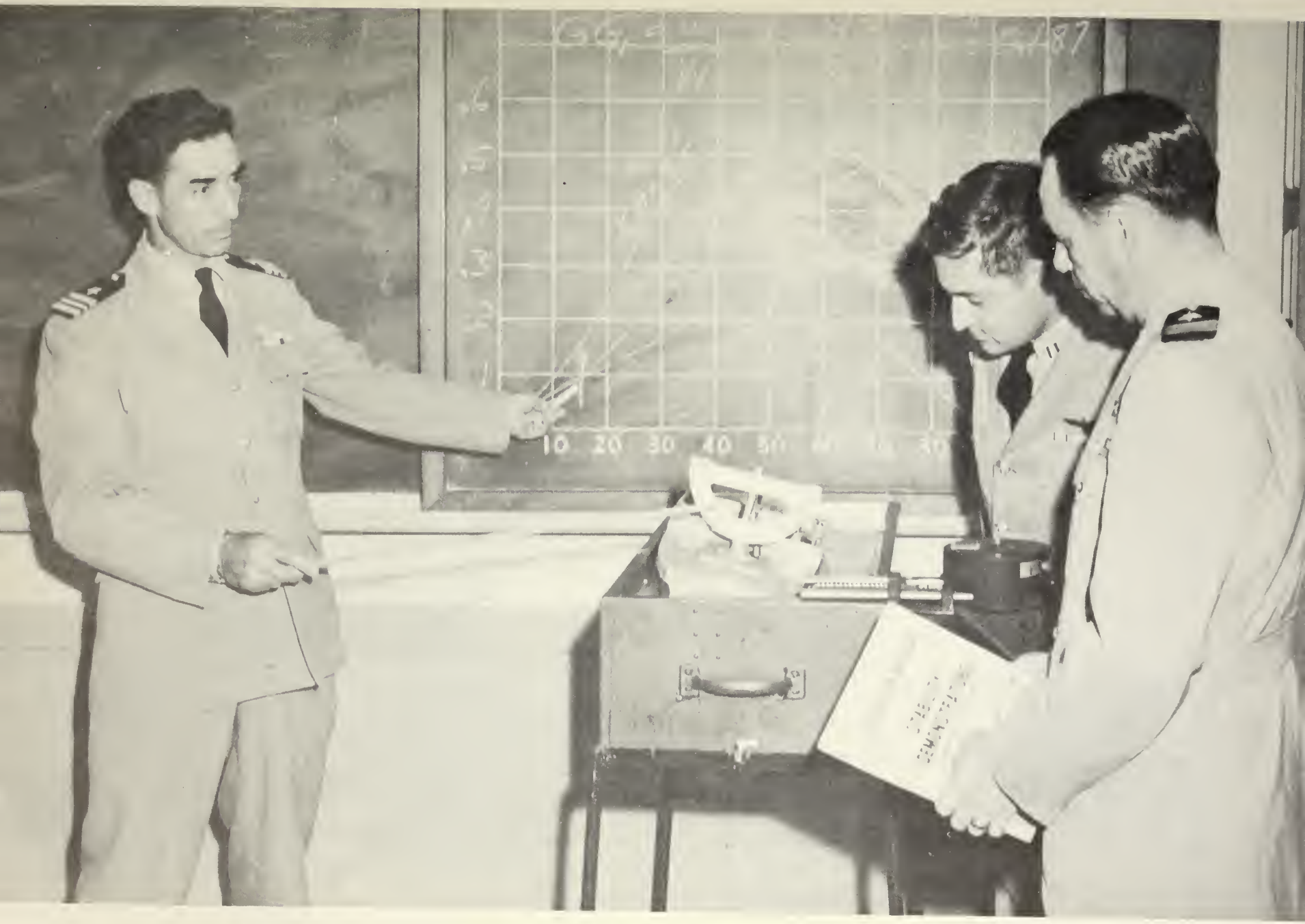
Prerequisite: Ph-731(A).

**Ph-740(A) Introductory Quantum Mechanics** 3-0

Schroedinger's wave mechanics, with application to such problems as the free particle, particle in a potential well, harmonic oscillator and the hydrogen atom.

Text: None.

Prerequisite: Ph-641(B) or equivalent.

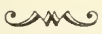


General Line School Naval Engineering and Damage Control instructor illustrating ship characteristics.


General Line School instruction in Seamanship.

## SECTION III

# GENERAL LINE SCHOOL
# of the
# U. S. NAVAL POSTGRADUATE SCHOOL



PART I GENERAL INFORMATION

1. Objective
2. Current Program
3. Military Staff
4. Civilian Faculty

PART II CURRICULA DESCRIPTIONS

GENERAL LINE SCHOOL

# ACADEMIC CALENDAR
## 1952—1953

The schedule consists of three terms, each lasting 15 weeks; three practice cruises, one for each main group of approximately 169 officers, and several field trips at the end of each term.

1952

| | |
|---|---|
| Registration begins | March 12 |
| First term begins | March 17 |
| Memorial Day (holiday) | May 30 |
| First term ends | June 27 |
| Seminar week from<br>through | June 30<br>July 3 |
| Independence Day (holiday) | July 4 |
| Second term begins | July 7 |
| Summer leave period from<br>through | August 23<br>August 31 |
| Labor Day (holiday) | September 1 |
| Second term ends | October 24 |
| Seminar week from<br>through | October 27<br>October 31 |
| Third term begins | November 3 |
| Armistice Day (holiday) | November 11 |
| Thanksgiving Day (holiday) | November 27 |
| Christmas leave period from | December 20 |

1953

| | |
|---|---|
| through | January 4 |
| Washington's Birthday (holiday) | February 23 |
| Third term ends | February 26 |
| Commencement | February 27 |

1952

| JANUARY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | •• | •• |

| FEBRUARY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | •• |
| •• | •• | •• | •• | •• | •• | •• |

| MARCH | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | •• | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | •• | •• | •• | •• | •• |

| APRIL | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| MAY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | 1 | 2 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

| JUNE | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | •• | •• | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| JULY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| AUGUST | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | •• | •• | •• | •• | •• | •• |

| SEPTEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | •• | •• | •• | •• |

| OCTOBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | •• |
| •• | •• | •• | •• | •• | •• | •• |

| NOVEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | •• | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | •• | •• | •• | •• | •• | •• |

| DECEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

1953

| JANUARY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| •• | •• | •• | •• | •• | •• | •• |

| FEBRUARY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| •• | •• | •• | •• | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| MARCH | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | •• | •• | •• | •• |

| APRIL | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| MAY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | •• | •• | •• | •• | •• | •• |

| JUNE | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | •• | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| JULY | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | •• |
| •• | •• | •• | •• | •• | •• | •• |

| AUGUST | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | •• | •• | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 30 | 31 | •• | •• | •• | •• | •• |

| SEPTEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | •• | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

| OCTOBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | •• | •• | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| • | •• | •• | •• | •• | •• | •• |

| NOVEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | •• | •• | •• | •• | •• |

| DECEMBER | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| •• | •• | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | •• | •• |
| •• | •• | •• | •• | •• | •• | •• |

# PART I—GENERAL INFORMATION

## 1. OBJECTIVE

To provide an integrated course in Naval Science to broaden the professional knowledge of unrestricted line officers of the Regular Navy.

## 2. CURRENT PROGRAM

The conduct of a general line course, approximately one year in duration, to provide a standardized professional educational experience for ex-Reserve and ex-Temporary officers who have been transferred to Regular status.

## 3. MILITARY STAFF

### Administration

JOHN STEUERT TRACY, Captain, U. S. Navy
Director of the General Line School

CHARLES COLEMAN TIDWELL, JR., Lieutenant Commander, U. S. Navy
Assistant to the Director

JEAN LESLIE STRICKLAND, Lieutenant (junior grade), U. S. Navy
Electronics Officer (Materiel)

### Command and Staff Department

CHARLES EDWARD ROBERTSON, Captain, U. S. Navy
Head of Department and Flight Liaison Officer

RAYMOND JOHN PFLUM, Commander, U. S. Navy
Senior Logistics Instructor

OSCAR WILLIAM GOEPNER, Commander, U. S. Navy
Administration and Leadership Instructor

JOE CUNDIFF ELIOT, Commander, U. S. Navy
Logistics Instructor

THOMAS R. FONICK, Commander, U. S. Navy
Military Law Instructor

FRANCIS TAYLOR COOPER, Commander, U. S. Navy
Administration and Leadership Instructor

VALENTINE GEHARD HOLZAPFEL, Commander, U. S. Navy
Senior Aviation Instructor

JOSEPH MARVILLE KELLAM, Commander, U. S. Navy
Aviation Instructor

JOHN POWERS BARRON, Commander, U. S. Navy
Military Law Instructor

HERBERT CLEO HOLLANSWORTH, Lieutenant Commander, U. S. Navy
Administration and Leadership Instructor

ROBERT JOHN GERHARDT, Lieutenant Commander, U. S. Navy
Logistics Instructor

THOMAS SINCLAIR MONTGOMERY, Lieutenant, U. S. Navy
International Law Instructor

JOHN JOSEPH REIDY, JR., Commander, U. S. Navy
International Law Instructor

SAUL MYER WEINGARTEN, Lieutenant, U. S. Navy
Military Law Instructor

**Naval Engineering and Damage Control Department**

WILLIAM CAMP FITZHUGH ROBARDS, Captain, U. S. Navy
Head of Department

ELI VINOCK, Commander, U. S. Navy
Senior Naval Engineering Instructor

WILLIAM WADE GENTRY, Commander, U. S. Navy
Naval Engineering Instructor

THEODORE JAMES MARTENS, Commander, U. S. Navy
Naval Engineering Instructor

PRESTON RAYMOND RITTER, Lieutenant Commander, U. S. Navy
Senior Damage Control Instructor

ALLEN WESLEY BAIN, Lieutenant Commander, U. S. Navy
Damage Control Instructor

ROSS PETERS, Lieutenant, U. S. Navy
Damage Control Instructor

E. E. LEBER, Lieutenant, U. S. Navy
Damage Control Instructor

**Operational Command Department**

EDWIN BYRON PARKER, Commander, U. S. Navy
Acting Head; Senior Naval Tactics Instructor

GORDON RALPH FISS, Commander, U. S. Navy
Senior CIC-ASW Instructor

STRAUSS SAMUEL LEON, Commander, U. S. Navy
Naval Tactics Instructor

JOSEPH DELOS FULLER, Lieutenant Commander, U. S. Navy
Communications Instructor

JOHN HARRY JORGENSON, Lieutenant Commander, U. S. Navy
Naval Tactics Instructor

FRANKLIN ERIC LEONARD HAWKINSON, Lieutenant Commander, U. S. Navy
CIC-ASW Instructor

NORMAN ALLAN SMITH, Lieutenant Commander, U. S. Navy
Naval Tactics Instructor


Aerial view of Monterey showing the "La Mesa Village" housing in the left foreground, the school buildings near the shore in the center, city of Monterey at the left, and the Naval Auxiliary Air Field at the right. The Del Monte public golf course is shown in the foreground. The airplane shown is one of the planes used for flight proficiency by the students.

A view of the Naval Auxiliary Air Field showing the planes used for flight proficiency by the students of the Naval Postgraduate School.

GEORGE W. KNIGHT, Lieutenant Commander, U. S. Navy
Communications Instructor

EARL HENRY LEACH, Lieutenant Commander, U. S. Navy
Communications Instructor

CARL WILLIAM BURROWS, JR., Lieutenant, U. S. Navy
CIC-ASW Instructor

**Ordnance and Gunnery Department**

JAMES FREDERICK BENNET JOHNSTON, Commander, U. S. Navy
Acting Head; Senior Ordnance and Gunnery Instructor

ROGER FARRINGTON MILLER, Commander, U. S. Navy
Senior Ordnance and Gunnery Instructor

CECIL CLARK, Commander, U. S. Navy
Ordnance and Gunnery Instructor

BERNARD MARTIN SOREM, Lieutenant Commander, U. S. Navy
Ordnance and Gunnery Instructor

JOHN WILLIAM MEYER, Lieutenant Commander, U. S. Navy
Ordnance and Gunnery Instructor

**Seamanship and Navigation Department**

JAMES EVERETT JOHNSON, Commander, U. S. Navy
Head of Department

GEORGE WAUGH ALBIN, JR., Commander, U. S. Navy
Senior Seamanship Instructor

PAUL EMIL LOUSTAUNAU, Commander, U. S. Navy
Senior Navigation and Submarine Instructor

HARRY VICTOR HARTSELL, Lieutenant Commander, U. S. Navy
Seamanship Instructor

RUSSELL "C" MEDLEY, Commander, U. S. Navy
Navigation and Submarine Instructor

BURTON FLOYD JOHN ALBRECHT, Lieutenant Commander, U. S. Navy
Meteorology Instructor

DAVID ARTHUR LONG, Lieutenant, U. S. Navy
Navigation Instructor

## 4. CIVILIAN FACULTY

**Department of Electrical Engineering and Mathematics**

FRANK EMILIO LaCAUZA, B.S., M.S., M.A.
Head of Department; Professor of Electrical Engineering

EDWARD MARKHAM GARDNER, B.S., M.S.
Associate Professor of Electrical Engineering

JOHN DeWITT RIGGIN, B.S., M.S.
Associate Professor of Electrical Engineering

DAVID BOYSEN HOISINGTON, B.S., M.S.
Associate Professor of Electrical Engineering

RAYMOND KENNETH HOUSTON, B.S., M.S.
Associate Professor of Electrical Engineering

RAYMOND PATRICK MURRAY, B.S.
Assistant Professor of Electrical Engineering

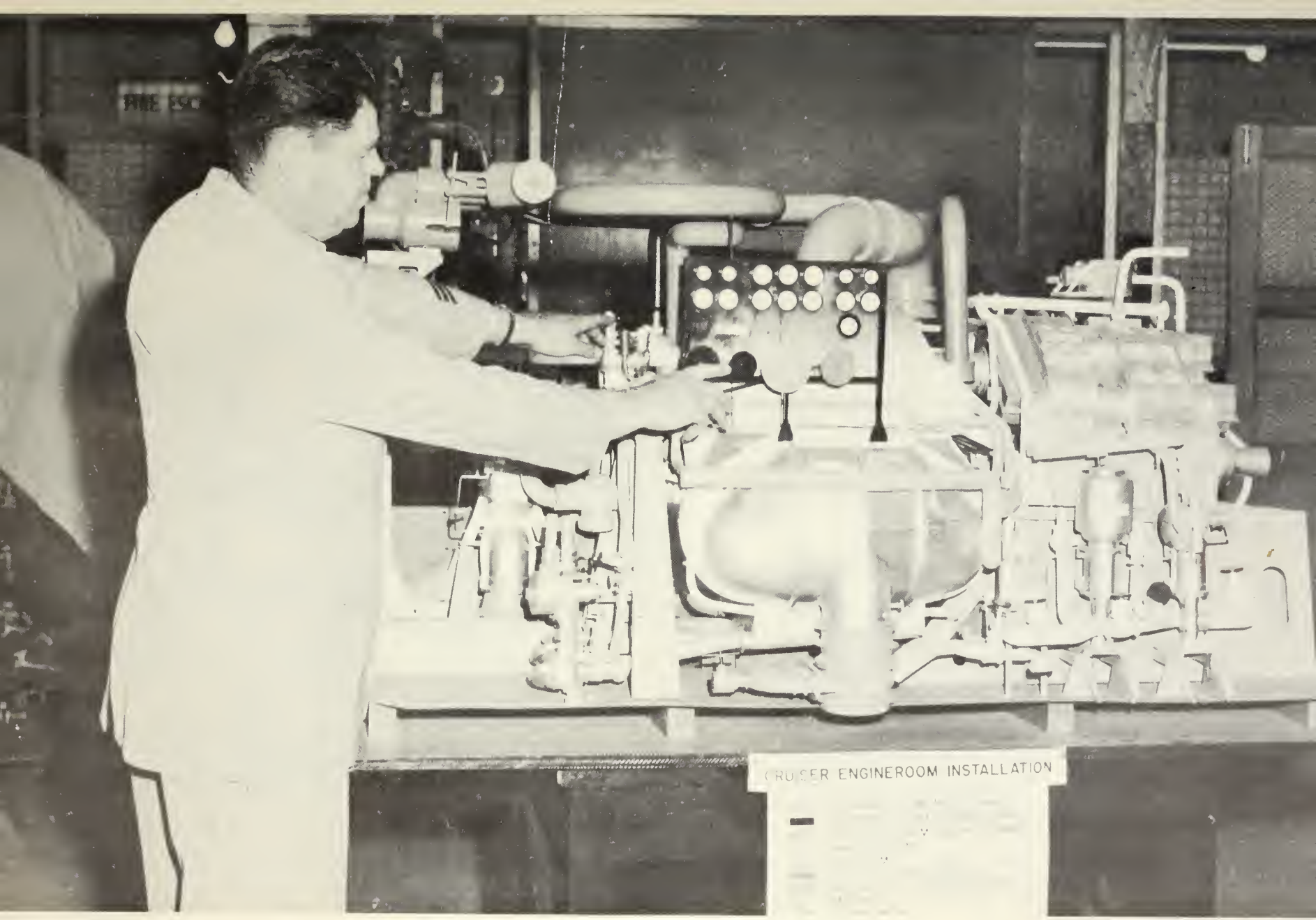
JOHN PERSHING PADDOCK, B.S., M.S.
Assistant Professor of Electrical Engineering

JOHN PHILIP PIERCE, B.S., M.E.E.
Associate Professor of Electrical Engineering

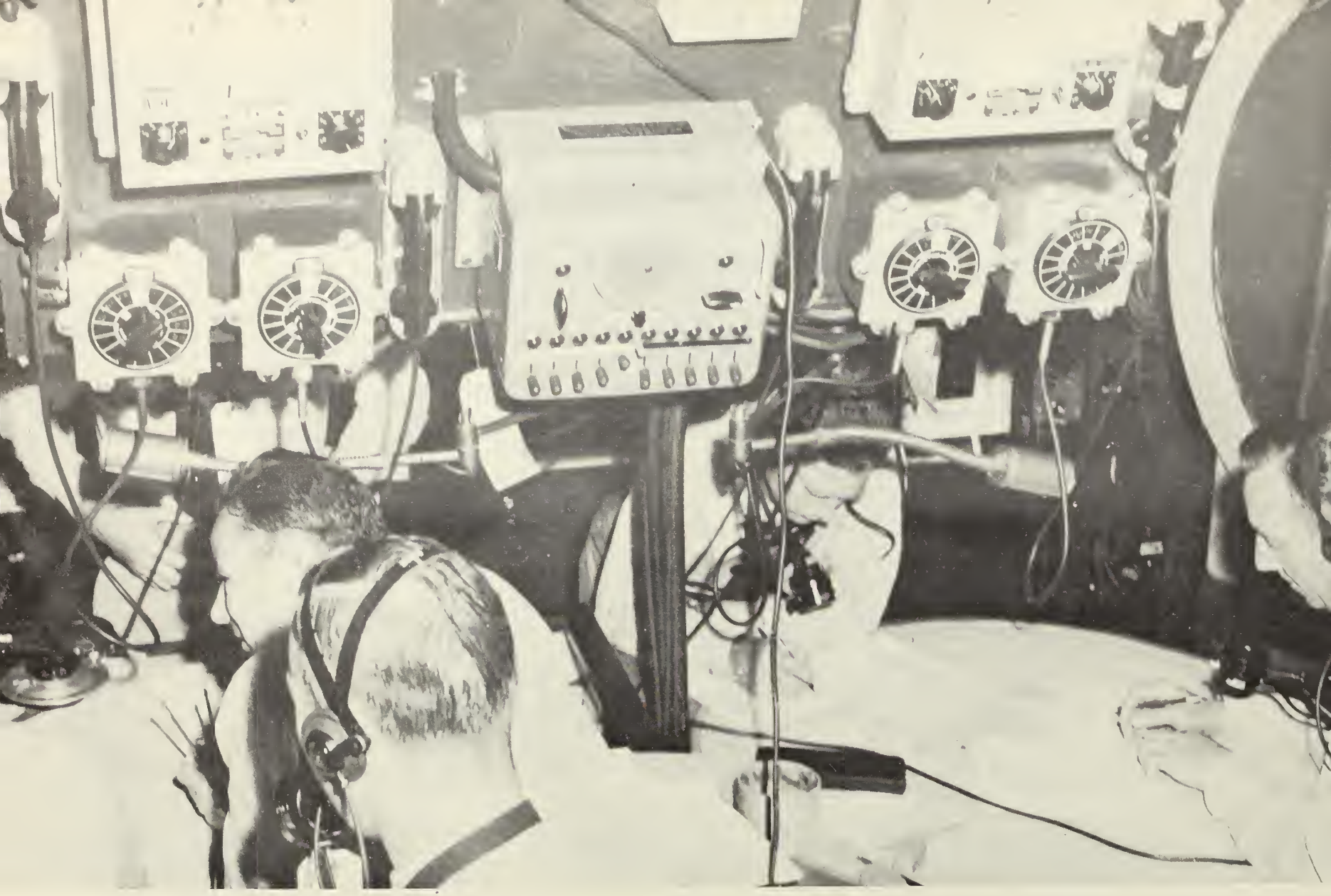
DARREL JAMES MONSON, B.S., M.S.
Assistant Professor of Electrical Engineering

WILLIAM EVERETT NORRIS, B.S., M.S.
Assistant Professor of Electrical Engineering

HERBERT LEROY MYERS, B.S.
Instructor of Electrical Engineering




General Line School Naval Engineering Damage Control instructor demonstrating with a model of a cruiser engineroom installation.



General Line School class receiving CIC instruction.

# PART II

# CURRICULA FOR STUDENT OFFICERS

## DEPARTMENTAL HOUR ALLOCATION 1952-53

| | |
|---|---|
| Command and Staff | 318 |
| Electrical Engineering and Mathematics | 196 |
| Naval Engineering and Damage Control | 112 |
| Operational Command | 203 |
| Ordnance and Gunnery | 119 |
| Seamanship and Navigation | 154 |
| Total | 1102 |

## COMMAND AND STAFF

### OBJECTIVES

General: To provide instruction and training in the various fields within the broad scope of the naval profession, principally in the non-technical areas not within the province of other departments, and those concerned with administration and the exercise of command.

Administration and Leadership: To emphasize the customs, traditions and courtesies of the naval profession; to familiarize each officer with general naval administration; to create an appreciation of personal and professional improvement through career and personal planning; to present techniques of leadership and their application by means of the case system: to train each officer in instruction methods, techniques and programs, and develop ability in public speaking.

Military Law: To teach the fundamentals of Military Law based upon the Uniform Code of Military Justice and the Manual for Courts-Martial, 1951 (including the Naval Supplement thereto), to the end that the administration of justice in the U. S. Naval Service will be sustained and strengthened.

International Law: To establish a familiarity with the basic principles of International Law and to develop the practical aspects with relation to the naval officer in the conduct of his professional duties.

International Relations: To stimulate an interest in world affairs through an understanding of the international scene and the place of the United States in that scene.

Intelligence: To provide a background for an understanding and appreciation of the role of intelligence in the formulation of national policy and of strategy, and in the planning and execution of military operations.

Logistics: To acquaint officers with the fundamentals and vital importance of logistics in formulating national policy and strategy, and in the planning and execution of military operations in support thereof; to instruct officers in all elements involved in the conduct of military logistics.

Aviation: To provide aviators and non-aviators with information appropriate to each group by separately conducted courses in order to broaden their knowledge and equip them for more effective performance in or in cooperation with naval aviation; to present to non-aviators a basic concept of problems, operations and capabilities; to give aviators information on recent developments, and to advance their knowledge as pilots in matters concerned with all-weather flying.

### ADMINISTRATION AND LEADERSHIP

| Subject | Hours |
|---|---|
| Career and Personal Planning | 12 |
| Military Leadership | 20 |
| Administration | 24 |
| Instructor Training and Public Speaking | 34 |
| | 90 |

### MILITARY LAW

| | |
|---|---|
| History of Law and UCMJ; Jurisdiction | 7 |
| Punitive Articles; Charges and Specifications | 11 |
| Evidence and Practical Trial Problems | 13 |
| Legal and Disciplinary Processes | 4 |
| Courts of Inquiry; Courts-Martial | 31 |
| Reviews of Courts-Martial | 4 |
| | 70 |

### INTERNATIONAL LAW

| | |
|---|---|
| History and Nature; Characteristics of States | 4 |
| Jurisdiction | 3 |
| Treaties; Diplomatic Representations; Peaceful Settlements | 4 |
| Procedures and Rules of War | 9 |
| | 20 |

### INTERNATIONAL RELATIONS

| | |
|---|---|
| Lectures on International Topics | 20 |
| Panel Discussion of Lectures | 10 |
| | 30 |

### INTELLIGENCE

| | |
|---|---|
| Intelligence Organizations | 2 |
| Demonstration Problems; Air Objectives | 5 |
| Counterintelligence; Psychological Warfare | 3 |
| | 10 |

### LOGISTICS

| | |
|---|---|
| Governmental and Military Logistics Organizations | 8 |
| Naval Supply and Procurement | 20 |
| Maintenance and Personnel | 11 |
| Transportation | 9 |
| Theatre Logistics; Logistic Computations | 8 |
| | 56 |

### AVIATION

Aviators

| | |
|---|---|
| Jets—Power and Operations | 13 |
| Missions of Naval Aviation | 6 |
| USAF Organization; Carriers | 2 |
| All-Weather Flying | 21 |
| | 42 |

Non-Aviators

| | |
|---|---|
| History and Fundamentals | 7 |
| Carrier Aircraft Operations | 4 |
| Multi-engine Operation; Air Tactics | 6 |
| Missions of Naval Aviation | 6 |
| All-Weather Flying; LTA and Helicopters | 5 |
| Jet Operations and New Trends | 11 |
| Observing Operations | 3 |
| | 42 |

## ELECTRICAL ENGINEERING AND MATHEMATICS

### OBJECTIVE

To review or give enough of the fundamentals of mathematics up to, but not including, the calculus as a background for all technical subjects to be studied in the line curriculum; to give enough of the fundamentals of mechanics, sound, light, DC and AC circuits, magnetism, radio and radar, and electronics to aid in the understanding of the subjects covered in Electrical Engineering, Naval Engineering, Communications, CIC, Ordnance and Gunnery, and Radiological Safety, and to acquaint the student with the operating characteristics of electrical naval equipment such as various types of motors, generators, and transformers.

| Subject | Hours |
|---|---|
| Mathematics | 45 |
| Mechanics | 14 |
| Sound | 8 |
| Light | 8 |
| DC Circuits | 17 |
| DC Machinery | 13 |
| AC Circuits | 24 |
| AC Machinery | 28 |
| Electronics | 32 |
| Radio and Radar | 7 |
| | 196 |

## NAVAL ENGINEERING AND DAMAGE CONTROL

### OBJECTIVES

Naval Engineering: To give student officers a broad basic knowledge of the operation and maintenance of a ship's engineering plant by instruction in the layout of the plant as a whole; details of construction, principles of operation, and operation and maintenance of the various components of a ship's engineering plant; and instruction in the proper organization and administration of the Engineering Department.

Damage Control: To acquaint students with the necessity for Damage and Casualty Control; to instruct in the principles and methods of Damage and Casualty Control; to teach the fundamentals of stability and buoyancy and methods of analysis of the situation after damage; to introduce the students to Chemical and Biological Defense; to acquaint the students with the principles of Radiological Defense and protection against radiation hazards.

### NAVAL ENGINEERING

| Subject | Hours |
|---|---|
| Organization and Operating Procedures | 4 |
| Basic Thermodynamics | 2 |

| | |
|---|---|
| *Fundamentals of the Engineering Plant | 10 |
| Boilers and Related Auxiliaries | 13 |
| Turbines and Related Auxiliaries | 14 |
| Distilling Plants, Diesel Generators, etc. | 12 |
| Electrical Installations | 6 |
| Future Developments | 2 |
| | 63 |

DAMAGE CONTROL

| Subject | Hours |
|---|---|
| Damage Control Fundamentals | 10 |
| Stability and Buoyancy | 19 |
| Preparation to Resist Damage; Corrective Measures | 5 |
| Gas Defense, Biological Warfare Defense, and Radiological Defense | 15 |
| | 49 |

*Note: When cruise ship is available, each student is given 11 hours of Naval Engineering and 6 hours of Damage Control practical instruction on board ship.

## OPERATIONAL COMMAND

### OBJECTIVES

CIC and ASW: To demonstrate and instruct officers in correct procedures for the operation and organization (air and surface) of Combat Information Center and in the fundamentals of Anti-Submarine Warfare.

Communications: To familiarize the student with the organization, responsibilities, functions and procedures of the Naval Communication Service; to give them practical experience in working with the Allied Naval Signal Book and visual signalling; to study the existing instructions for security, care and handling of classified matter; to provide an interpretive understanding of the Armed Forces Operation Plan and Order Form; to examine the Communication problems involved in naval operations and acquaint the student with the variable contents and forms of both Communication plans.

Naval Tactics: To provide a working knowledge of the use of the maneuvering board in solving simple time, speed, and distance problems, problems in close order maneuvering, and those commonly met in tactical formations and dispositions at sea; a familiarity with naval operations in general and the relationship of these operations to the conduct of war; and a working knowledge of General Tactical Instructions and certain typical special purpose and type tactical instructions commonly encountered in naval operations during peace and war.

CIC AND ASW

| Subject | Hours |
|---|---|
| Anti-Submarine Warfare Functions | 9 |
| Organization and Operation of ASW | 5 |
| Anti-Submarine Warfare Equipments; Practical Works | 14 |
| Combat Information Center Functions | 9 |
| Organization and Operation of CIC | 5 |
| CIC Equipment; Practical Works | 14 |
| | 56 |

COMMUNICATIONS

| | |
|---|---|
| Communication Organization and Procedures | 24 |
| Security of Classified Matter | 7 |
| Operational Planning and Communication Plans | 18 |
| | 49 |

NAVAL TACTICS

| | |
|---|---|
| Maneuvering Board Fundamentals and Formation Problems | 32 |
| General Tactical Instructions and Naval Operations (General) | 33 |
| Destroyer Type Tactics | 3 |
| Fast Carrier Task Force Instructions | 10 |
| Surface Action and Tactics | 6 |
| Amphibious Warfare and Seminar Series | 14 |
| | 98 |

## ORDNANCE AND GUNNERY

### OBJECTIVES

To present a comprehensive course in Ordnance and Gunnery, giving an overall picture of the surface, air, and underwater aspects including (a) theoretical and practical principles of control, operation, and maintenance of modern gunnery equipment; (b) organization and administration of the shipboard Gunnery Department; (c) limitations and capabilities of naval armament; and (d) future trends in naval gunnery, guided missiles, underwater ordnance, and atomic weapons.

| Subject | Hours |
|---|---|
| Ammunition and Safety Precautions | 8 |
| Guns and Assemblies | 12 |
| Elements of Fire Control | 22 |
| Fire Control Equipment | 10 |
| Fire Control Optics and Radar | 5 |
| Relative Rate Fire Control Systems | 10 |
| Employment of Shipboard Fire Control Systems | 15 |
| Power Drives | 6 |
| Underwater Ordnance | 10 |
| Organization, Administration and Training | 4 |
| Aviation Ordnance | 7 |
| Rockets and Guided Missiles | 10 |
| | 119 |

## SEAMANSHIP AND NAVIGATION

### OBJECTIVES

Seamanship: To present a theoretical and background knowledge of seamanship, including shiphandling and the Rules of the Nautical Road, and to provide a practical application of seamanship practices during a week's cruise at sea and by use of shiphandling trainers.

Navigation: To provide a practical and theoretical knowledge of all phases of marine navigation.

Meteorology: To present sufficient theoretical and background knowledge concerning the subject of meterology for interpretation of a weather map and weather conditions and to provide practical utilization of information so gained in application to ship and air operations.

Submarines: To provide a basic knowledge of the capabilities and limitations of submarines.

### SEAMANSHIP

| Subject | Hours |
|---|---|
| Deck Seamanship Evolutions | 9 |
| Duties of the Officer of the Deck | 2 |
| Shiphandling | 11 |
| Rules of the Nautical Road | 16 |
| Shiphandling Trainer | 4 |
| Total Exclusive of cruise at sea | 42 |

### NAVIGATION

| | |
|---|---|
| Mechanics; Definitions, Chart Projections, Publications | 3 |
| Tide and Current Tables, Light Lists, Nautical Almanac | 5 |
| Magnetic Compass, Exact Azimuths | 4 |
| Piloting, Loran, Use of Radar | 6 |
| Nautical Astronomy, Star Identification; Time | 15 |
| Complete Solution and Latitude Sights | 8 |
| Duties of Navigator, Voyage Planning, Lifeboat Navigation | 4 |
| Practical Works | 39 |
| | 84 |

### METEOROLOGY

| | |
|---|---|
| Structure of the Atmosphere; the Weather Elements; The Station Model; Atmospheric Heat Processes | 3 |
| The Evaporation Condensation Cycle; Weather Map Construction; Clouds; Atmospheric Pressure and Wind | 3 |
| Secondary Winds; Air Masses and Fronts; Cyclone Structure and Movements; Weather Map Analysis | 6 |
| Tropical Storms; Principles of Forecasting | 3 |
| Single Station Forecasting; Source of Weather Information; Forecasting Aids; climatology | 3 |
| Weather Application at Sea; Flight Planning and Weather | 3 |
| | 21 |

### SUBMARINES

| | |
|---|---|
| Submarine Construction | 3 |
| Submarine Tactics and New Developments | 4 |
| | 7 |

## BUILDING LIST

| No. | Use |
|---|---|
| 201 | Barracks, Enlisted |
| 202 | Barracks, Enlisted |
| 203 | Barracks, Enlisted |
| 204 | Barracks, Enlisted |
| 205 | Barracks, C.P.O. |
| 206 | Aerology Classrooms, Student Mail Center |
| 207 | E.M. Laundry and Small Stores |
| 208 | Storage, Public Works |
| 209 | Solarium, Recreation |
| 210 | Dressing Rooms, Recreation |
| 211 | Recreation, Enlisted |
| 220 | Officers Mess Open, General Mess, Closed Mess, Administration, B.O.Q. |
| 221 | Postgraduate School Laboratories and Officer |
| 222 | B.O.Q., Administrative Command |
| 223 | Interim Engineering Laboratory |
| 224 | Interim Physics and Electronics Laboratory |
| 225 | Interim Metallurgy and Chemistry Laboratory |
| 226 | Interim Mechanical Engineering and Testing Laboratory |
| 227 | Interim Storage and Machine Shop |
| 228 | Interim Servo and Ordnance Laboratory |
| 229 | Interim Electronics Laboratory |
| 231 | Motor Generator Room and Radar Tower |

### SCHOOL NAVAL ENGINEERING

New Construction

| | |
|---|---|
| 232 | Electronics, Physics, Chemistry, Metallurgy, Aerology |
| 233 | Electrical Engineering |
| 234 | Mechanical and Aeronautical Engineering |
| 235 | Mathematics, Drafting Classrooms |
| 236 | Heating |

| | |
|---|---|
| 250 | Swimming Pool, Adult |
| 251 | Swimming Pool, Children |
| 252 | Tennis Courts |
| 253 | Tennis Courts |
| 300 | Academic Classrooms (Powers Hall) |
| 301 | Academic Classrooms (Fleming Hall) |
| 400 | Garage, Public Works |
| 401 | Garage, Public Works |
| 402 | Garage, Public Works |
| 403 | Firehouse |
| 404 | Transportation Repair Shop |
| 406 | Garage, Public Works; Station Police |
| 407 | Service Station, Ships Service |
| 408 | Rest Rooms, Ships Service |
| 409 | Repair Shop, Ships Service |
| 410 | Garage |
| 500 | Heating Plant |
| 501 | Shops Public Works |
| 502 | Paint Shop, Public Works |
| 503 | Storage, Public Works |
| 504 | Storage, Public Works |
| 509 | Gas Meter House |
| 511 | Gardeners' Tool Storage |
| 513 | Paint Storage, (S&A Shop Stores) |
| 514 | Storage (S&A Shop Stores) |
| 515 | Gate House |
| 516 | Storage (S&A Shop Stores) |
| A | Married Officers' Quarters |
| C | Married Officers' Quarters |
| D | Married Officers' Quarters |
| E | Married Officers' Quarters |
| F | Married Officers' Quarters |
| G | Married Officers' Quarters |
| H | Married Officers' Quarters |
| I | Married Officers' Quarters |
| J | Married Officers' Quarters |
| K | Married Officers' Quarters |
| L | Married Officers' Quarters |
| M | Married Officers' Quarters |

### PARKING AREAS

| | |
|---|---|
| A | Restricted and Visitors |
| B | Restricted and Visitors |
| C | Restricted |
| D | Restricted |
| E | Restricted |
| F | Restricted and Student |
| G | Unrestricted |
| H | Unrestricted |
| I | Unrestricted |
| J | Unrestricted |
| K | Unrestricted |
| L | Unrestricted |
| M | Restricted, Enlisted |
| N | Restricted, Enlisted |
| O | Restricted, Aerology |


U. S. NAVAL POSTGRADUATE SCHOOL
MONTERREY, CALIFORNIA
FREMONT
STREET